

**UNITED STATES DEPARTMENT OF AGRICULTURE
BUREAU OF CHEMISTRY AND SOILS**

In cooperation with the Massachusetts Department of Agriculture
Division of Reclamation, Soil Surveys, and Fairs

**SOIL SURVEY
OF
MIDDLESEX COUNTY, MASSACHUSETTS**

BY

**W. J. LATIMER, United States Department of Agriculture
in Charge, and M. O. LANPHEAR, Massachusetts
Department of Agriculture**

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SOIL SURVEY

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COUNTY SURVEYED

Middlesex County is in the eastern part of Massachusetts, its southeastern boundary abutting the city limits of Boston and its northern edge bordering New Hampshire. It is irregular in shape and covers a total area of 832 square miles, or 532,480 acres.

Middlesex County is divided into four distinct physiographic regions: The eastern highlands or central plateau of Massachusetts, the eastern plateau, the Sudbury Basin, and the Boston Basin.

The northwestern end of the county extends up on the central plateau. This area is only a small part of the county but is one of the outstanding physiographic divisions. The plateau lies from 790 to 1,300 feet above sea level and slopes gently to the east. It is severely dissected by deep, narrow valleys with steep side walls, and the eastern escarpment is steep. The surface of the remnants of the plateau is fairly smooth, consisting of flattened ridges and smooth rounded hills with a few low knobs rising about 100 feet above the general level of the plateau. The outstanding feature of this region, as well as of the whole county, is Watatic Mountain in the extreme northwestern corner. This mountain rises 1,847 feet¹ above sea level and 500 feet above the highest level of the plateau.

The eastern plateau, covering most of the county, extends from the escarpment of the central plateau in the western part of Townsend to its own well-defined escarpment passing through Waltham, Arlington, and Malden in the southeastern part of the county. It occupies all the intervening territory, except the comparatively small area of the Sudbury Basin in the south-central part of the county. The general elevation, with the exception of the higher ridges and hills representing the peneplain, is from 200 to 500 feet above sea level. The elevations are highest in the western part of the county, and the general slope is to the east. The surface of the plateau is decidedly uneven, dipping first to the east and southeast into the Sudbury Basin then rising again before dipping to the east, southeast, north, and northeast. It is traversed by numerous broad, shallow-stream valleys which include many level terraces or outwash plains.

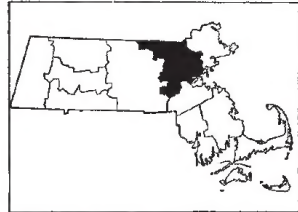


FIGURE 1.—Sketch map showing location of Middlesex County, Mass.

¹ Gannett, Dictionary of Altitudes.

Middlesex County is comparatively smooth, the valley walls are gently sloping, and the hills are smoothly rounded, with somewhat flattened tops in places. The hills and ridges of the central, southern, and eastern parts of the county have no general arrangement or system. The bases of most of the hills are oval, with the long axis in a general north-south direction. The region between Nashua River and the escarpment of the central plateau consists of low, broad, flat-topped parallel ridges extending north and south or inclined slightly northeast and southwest. In Groton, east of Nashua River, is a group of smooth, rounded hills having a typical drumlin relief. In the western and southwestern parts, along the Worcester County line, the hills are higher and the land is more broken. In the northeastern part, the relief is even more subdued than in the remainder of the plateau, and in this region extensive outwash plains occur between the hills and ridges. The outstanding features of the eastern plateau are an intermittent ridge that extends through Littleton, Westford, and Chelmsford and a number of isolated hills or knobs that rise several hundred feet above the general level of the plateau. The most conspicuous of these knobs are Prospect, Whortleberry, and Robbins Hills in the northern part, Annursnack Hill in the central part, and Prospect (Waltham), Nobscot, and Reeves Hills in the southern part of the county.

The Sudbury Basin comprises a broad, irregularly oval-shaped belt of country in the south-central part of the county, surrounded, except for the outlets, by the eastern plateau. It consists of extensive, level or nearly level outwash plains and terraces with elevations ranging from 20 to 100 feet above stream level and from 100 to 200 feet above sea level. The plains and terraces are broken by small, low, smooth hills and a few drumlins. The basin is traversed by broad, shallow, stream valleys, many of which are marshy.

The Boston Basin is in the southeastern part of the county between the eastern escarpment of the eastern plateau and tidewater. It consists of low, level terraces ramified by arms of salt-water streams that are bordered in places by comparatively narrow tidal marshes. The terraces rise from 10 to 50 feet above sea level and are broken by low, smoothly rounded hills or drumlins which rise from 100 to 150 feet above the level of the terraces and are the outstanding features of the basin.

The county drains into three main drainage basins, Nashua River, Concord River, and Charles River. The northwestern quarter is drained by Nashua River and its main tributary, Squannacook River. Nashua River flows north into New Hampshire and empties into Merrimack River. Concord River, through its main tributaries, Sudbury River and Assabet River, drains the central and greater part of the county. Charles River drains the southern and southeastern parts, and Mystic, Ipswich, and Shawshine Rivers drain a narrow strip along the eastern edge.

The valleys are from 100 to 200 feet below the general level of the upland over most of the county and from 200 to 400 feet in the western corner. The streams are not actively engaged in cutting back into the upland, and are for the most part sluggish. A few small water-power sites are in use in different parts of the county.

A large power development is located at Lowell, on Merrimack River, and others are in operation on Charles River. Owing to the absorptive power of the soils of the county and to the presence of many lakes and ponds, the run-off of surface water is very slow. The volume of water in the streams fluctuates very little, as compared to regions where the run-off is rapid.

Many small lakes and ponds are scattered over the county. There are several artificial reservoirs, the largest embracing the Framingham Reservoirs of the Boston metropolitan waterworks system. The largest poorly drained areas are along Sudbury, Concord, and Shawshine Rivers. Extensive areas of muck, which represent filled-in lakes and stream basins, occur in nearly all parts of the county. Most of the small-stream bottoms and the tidal marsh along the salt streams are poorly drained. The upland, which comprises most of the county, is well drained, with the exception of a few small areas.

Middlesex County was settled by the English during the early colonization of Massachusetts. The first settlements were made in the vicinity of Cambridge in 1630. Much of the present population is descended from the original settlers or from native stock from adjacent counties or other New England States. Large numbers of Irish have come into the county in the last 50 or 60 years, and Italians and other foreigners have entered during recent years.

Middlesex County was incorporated May 10, 1643. At the present time it has 54 civil divisions, consisting of 11 cities and 43 towns. The population of the county, according to the 1920 census, was 778,352, or 935.5 persons to the square mile. Of this total 72.3 per cent were native white, and 26.4 were foreign-born white. A group of 8 cities and 6 towns in the southeastern part of the county are included in the metropolitan district of the city of Boston and constitute the most thickly settled part of the county. These cities and towns contain 65.3 per cent of the population of the county and, aside from Lowell, Marlboro, and Framingham, are the largest towns in the county. They are populated largely by people who work in Boston.

Lowell, the largest city, has a population of 112,759. It is in the northern part of the county and is an important manufacturing center. Cambridge, the county seat, has a population of 109,694 and is a residential city although some factories are located there. It is the seat of Harvard University, the Massachusetts Institute of Technology, and Radcliffe College. Somerville, adjoining Cambridge, is a city of 93,091 population. It is a residential and manufacturing center. Meat packing and the manufacture of metal products are the leading industries. Tufts College is in this city. Cambridge and Somerville both lie within the metropolitan district, as do also the following residential and manufacturing towns and cities: Malden (city), population 49,103; Newton (city), population 46,054; Everett (city), 40,120; Medford (city), 39,038; Waltham (city), 30,915; Watertown (town), 21,457; Arlington (town), 18,665; Melrose (city), 18,204; Wakefield (town), 13,025; Belmont (town), 10,749; Winchester (town), 10,485; and Stoneham (town), 7,873.

The following are important manufacturing and residential towns outside the metropolitan district: Framingham, 17,033; Marlboro

(city), 15,028; Natick, 10,907; and Hudson, Maynard, Lexington, Concord, Reading, Chelmsford, and Dracut, all of which have a population ranging from 5,000 to 8,000. Of the remaining towns, five have populations ranging from 2,500 to 5,000, and 20 have less than 2,500. Less than 5 per cent of the population is classed as rural—that is, living in towns of less than 2,500 population. All the towns outside the metropolitan district include considerable farm land and even those within that district include a number of truck farms.

Middlesex County is well supplied with transportation facilities. The water front in the southeastern end forms part of the port of Boston, and some of the terminal facilities of that port are located in the cities in this vicinity. The Boston & Albany Railroad (double track) main line passes east and west through the southern part of the county. Four lines of the Boston & Maine Railroad radiate north, northwest, and west from Boston, serving the northern end of the county. A branch line of the New York, New Haven & Hartford Railroad system passes through the county north and south. A number of branch lines from these three systems extend to nearly all parts of the county.

Excellent street railway and trolley systems connect the cities and towns of the metropolitan district with Boston. The Boston & Worcester electric line passes through the southern part of the county, and the Lowell-Fitchburg line through the northern end. A number of electric lines that reached nearly all the towns of the county have been removed in recent years and replaced by motor-bus lines.

Good surfaced State highways radiate from Boston over the county, and a network of county and town roads, most of them surfaced and the remainder graveled, extend to all parts. Most of the secondary roads are graveled. Telephones and rural mail routes or city mail delivery reach all parts of the county. All cities and most towns are supplied with electric lights, waterworks, sewers, and fire protection.

The city of Boston and the cities and towns of the metropolitan district are the principal markets for the farm products of the county. Lowell and the other industrial and residential towns outside this district furnish excellent local markets.

CLIMATE

Middlesex County is in the humid region of the United States. The climate is marked by long, cold winters with a heavy snowfall and by medium short summers.

Little difference appears in the temperature records from the stations at Lowell and Concord. The northwestern part of the county is more nearly represented by the records at the Fitchburg station, which is located near the county line in Worcester County. This station shows a greater range in temperature.

The rainfall is well distributed throughout the year, the average approximating 10 inches for each of the three-month seasons. The snowfall is heavy.

The time elapsing between the average date of the last killing frost in spring and of the first in fall at Concord is 4 months and 21 days and at Lowell is 5 months and 15 days. Thus the average frost-free

season is about 5 months. Early frosts in fall and late in spring are more common on the lower areas than on the higher. The climate along the coast is tempered to some extent by the influence of the ocean.

The length of the growing season is ample to mature a wide range of crops. The cool humid climate favors the growth of grass during the growing season and the hay crop has always been important. Although livestock should be housed during the winter, the climate may be considered good for stock raising and dairying. The climatic conditions, except in the lower areas, are well suited to fruit raising. Apples and peaches of many varieties and other fruits thrive. Where coldframes are used for starting and fertilizer for pushing crops, two crops of certain vegetables can be produced. In a normal season practically all vegetables grown in the Northern States will mature before frost.

Tables 1 and 2 give the normal monthly, seasonal, and annual temperature and precipitation, as recorded by the United States Weather Bureau stations at Concord and Lowell.

TABLE 1.—*Normal monthly, seasonal, and annual temperature and precipitation at Concord*

[Elevation, 139 feet]

Month	Temperature			Precipitation		
	Mean	Absolute maximum	Absolute minimum	Mean	Total amount for the driest year (1894)	Total amount for the wettest year (1898)
	^{° F.}	^{° F.}	^{° F.}	<i>Inches</i>	<i>Inches</i>	<i>Inches</i>
December.....	27.6	67	-17	3.36	3.11	2.77
January.....	23.3	64	-19	3.48	2.47	4.50
February.....	24.3	57	-25	3.08	2.69	4.57
Winter.....	25.1	67	-25	9.92	8.27	11.84
March.....	34.2	74	-2	3.46	.93	1.87
April.....	45.2	86	13	3.28	2.10	4.48
May.....	56.0	92	29	3.30	4.22	2.81
Spring.....	45.1	92	-2	10.04	7.25	9.16
June.....	65.4	98	33	2.97	.63	2.36
July.....	70.0	98	41	3.64	3.22	5.80
August.....	67.3	98	36	3.50	1.81	8.94
Summer.....	67.6	98	33	10.11	5.66	17.10
September.....	60.7	95	23	3.49	2.21	2.34
October.....	50.2	82	20	3.05	4.20	6.43
November.....	38.2	74	5	3.31	3.28	5.02
Fall.....	49.7	95	5	9.85	9.69	13.79
Year.....	46.9	98	-25	39.92	30.77	51.89

TABLE 2—*Normal monthly, seasonal, and annual temperature and precipitation at Lowell*

[Elevation, 100 feet]

Month	Temperature			Precipitation		
	Mean	Absolute maximum	Absolute minimum	Mean	Total amount for the driest year (1914)	Total amount for the wettest year (1888)
December.....	° F. 28.8	° F. 64	° F. -20	<i>Inches</i> 3.74	<i>Inches</i> 2.91	<i>Inches</i> 5.32
January.....	23.8	59	-14	3.77	2.59	5.16
February.....	25.1	57	-25	4.36	1.57	4.55
Winter.....	25.9	64	-25	11.87	7.07	15.03
March.....	32.5	72	-4	4.16	4.49	3.98
April.....	45.3	82	16	3.71	4.59	4.04
May.....	57.5	90	32	3.50	2.10	4.10
Spring.....	45.1	90	-4	11.37	11.18	12.12
June.....	66.8	98	33	3.22	1.22	3.00
July.....	71.5	98	44	3.29	2.26	3.64
August.....	69.4	98	42	3.51	2.71	5.22
Summer.....	69.2	98	38	10.02	6.19	11.86
September.....	62.0	90	28	3.63	.12	7.72
October.....	49.9	82	25	3.49	1.03	7.14
November.....	39.5	69	4	3.60	2.26	5.62
Fall.....	50.5	90	4	10.72	3.41	20.48
Year.....	47.6	98	-25	43.98	27.85	59.49

AGRICULTURE

Middlesex County is in the transition zone where the forest flora of the north (spruce, white birch, and hard maple) blend with that of the south (oak, poplar, and chestnut). The region was originally covered with a mixed growth of white pine, oak, chestnut, poplar, hard and soft maple, and white and gray birch. In the rocky and rough gorges of the northwestern part of the county considerable spruce is present; white pine predominates on the terraces, soft maple on the lowlands, and tamarack in the swamps.

The terraces and lowlands of the southeastern part of the county were the first areas to be settled, then the clearings spread to the hills and ridges of the adjacent regions until 75 or 80 per cent of the county was cleared and used for farming. Practically all the merchantable timber was removed long ago, and the second-growth timber has been cut over many times since the first settlements were made. Some of the land that at one time was used, especially that used for pasture, has been allowed to grow up in forest, and approximately 60 per cent of the total area, outside the cities, is now in second-growth forest. The second growth ordinarily differs from the original forest. Where pine is removed it is replaced by pine where conditions are favorable, but on droughty and sandy soils it is usually replaced by scrub oak. Much of the cut-over land in the upland is reforested by oak and chestnut, and many abandoned fields grow up to birch.

The early agriculture consisted of general farming and stock raising. Hay, corn, rye, oats, wheat, hemp, and potatoes were the staple crops grown, and vegetables and fruit were grown for home use. Cattle,

sheep, and poultry were raised, and milk cows were kept, largely for the production of dairy products for home use. As Boston grew into a great city market gardening began in the vicinity of Cambridge and Arlington. As the metropolitan district expanded over this area the market-garden farms were forced back into the surrounding country. As the population increased dairying took the place of stock raising, and general farming became of secondary importance or the farmers changed to fruit growing, market gardening, and poultry raising.

The area of land devoted to the production of general farm crops apparently reached a maximum between 1850 and 1880. Since that time there has been a marked decrease in the acreage of all the staple crops and an increase in that of corn for silage and in that of vegetables. At present the agriculture of the county consists of dairying, fruit raising, market gardening, and poultry raising, with general farming carried on to a small extent in connection with these industries.

Table 3 gives the acreage and yield of the principal crops, as reported by the 1920 census:

TABLE 3.—*Acreage and yield of principal crops in 1919*

Crop	Acre	Yield	Crop	Acre	Yield
		<i>Tons</i>			<i>Tons</i>
Timothy and clover.....	20, 205	28, 784	Silage crops.....	3, 105	32, 811
Timothy (alone).....	14, 856	22, 032			
Other cultivated grasses.....	12, 783	15, 486			<i>Bushels</i>
Wild or salt grass.....	1, 623	1, 795	Corn (grain).....	1, 682	95, 175
Grains cut green.....	2, 035	3, 890	Potatoes.....	2, 608	232, 940
Coarse forage.....	1, 994	6, 285	All other vegetables.....	7, 175	-----

In 1919 oats, wheat, rye, barley, and buckwheat occupied a total of 665 acres. Clover, alfalfa, and other legumes were grown for hay on 879 acres, root crops on 249 acres, and dry edible beans on 69 acres.

Of the vegetables grown for market, sweet corn occupied 2,058 acres; cabbage, 605 acres; and lettuce, 438 acres. The other vegetables grown on a smaller acreage include a wide variety of truck crops. Most of the market gardening is carried on in the towns that lie northwest of Boston and adjacent to the metropolitan district. The market-gardening interests of Lexington and Concord are rather extensive, much of the asparagus produced being grown in the vicinity of Concord. Vegetables, principally lettuce, tomatoes, and cucumbers, are grown rather extensively under glass in the Arlington-Belmont district.

Fruit growing consists largely of the growing of apples and is important only in the towns in the north-central part of the county, in what is known as the Nashoba fruit belt. Small orchards are, however, found in all parts of the county. The leading varieties of apples grown are Baldwin, McIntosh, Wealthy, Delicious, and Gravenstein.

Some peaches are grown on a commercial scale, principally in the same region as that of the commercial apple orchards. Elberta, Belle, Mountain Rose, Carman, Champion, and Early Crawford are leading varieties. Nearly all the farmers have small orchards in which apples, peaches, pears, and plums are grown. The pears usually grown are Bartlett, Sheldon, and Seckel.

According to the 1920 census there were in the county in 1919, 277,997 bearing apple trees that produced 1,069,613 bushels; 62,430 bearing peach and nectarine trees that produced 49,846 bushels; 18,260 bearing pear trees, that produced 17,711 bushels; 5,138 bearing plum trees, that produced 3,334 bushels; and 10,936 bearing grapevines, that produced 137,409 pounds.

Of the small fruits, berries were grown on 521 acres, with strawberries and cranberries occupying the largest acreage. A number of nurseries in the county grow fruit stocks, ornamental shrubs, and trees.

Dairying is important in nearly all parts of the county. The products consist almost entirely of whole milk, which is shipped to Boston and other cities or is sold locally. Holsteins compose a majority of the herds, but many Guernseys, Ayrshires, and Jerseys are kept. In 1920 there were 21,250 milk cows in the county.

The work animals are medium or light draft horses. The few sheep kept are largely mutton or dual-purpose types. The hogs are Duroc-Jersey, Chester White, Berkshire, and Poland China.

Most farmers keep some chickens, and many make a specialty of poultry raising. Several large poultry farms are in the county, and some of the flocks contain more than 1,000 birds. Practically all breeds of chickens are represented. There were 213,124 chickens in the county in 1920.

Table 4 gives the value of all agricultural products, by classes, as reported by the 1920 census:

TABLE 4.—*Value of agricultural products in 1919 by classes*

Product	Value	Product	Value
Cereals.....	\$200,829	Livestock and livestock products:	
Other grains and seeds.....	5,555	Animals sold and slaughtered.....	¹ \$1,516,872
Hay and forage.....	2,688,462	Dairy products (excluding home use).....	4,427,356
Vegetables.....	3,735,377	Poultry and eggs.....	1,140,459
Fruits and nuts.....	2,466,045	Wool.....	1,651
All other crops.....	669	Total.....	16,183,275

¹ Estimated.

Middlesex County ranked fifth in the counties of the United States in 1919 in the value of vegetables grown for market. To this county is credited the development of a considerable number of varieties of vegetables and of several notable varieties of fruits, including the Baldwin apple and the Concord grape.

A number of farmers grow flowers for sale, and a few farms are devoted entirely to this industry.

According to the 1920 census there are 4,446 farms in Middlesex County. This is a decrease of nearly 1,000 farms in the last decade but is only a few less than there were in 1900. The land in farms represents 48.3 per cent of the entire area of the county, or 257,165 acres. The remainder is largely used for cities and municipal purposes. Of the land in farms, 45.6 per cent is improved. This is a decrease of 65,590 acres of improved land since 1910. The 117,290 acres of improved land includes approximately 8,000 acres of tillage, mowing, and orchards, and 109,290 acres of pasture. Of the unimproved land in farms, 91,897 acres is in woodland and 47,978 acres is in brush pasture, fallow, and abandoned fields.

The physiography, relief, and soils influence the distribution of crops. The rougher broken and stony land has not been used for farming. The less broken but stony ground is used for pasture. It is on this class of land that most of the abandoned farms are found. The smoother less stony hills are utilized for hay. Orcharding has been developed mainly on the drumlins in the northern part of the county and on the eastern slope of the ridge that passes northeast and southwest through Littleton and Westford or on that part of the eastern plateau that slopes toward the Sudbury Basin. Market gardening began and developed largely on the terraces and drumlins of the Boston Basin. As the metropolitan district grew out over this territory, the market-garden farms were forced back until very few are left on the soils that are better adapted to the growing of truck crops. At the present time, much of the market gardening is conducted on the hills adjacent to the Boston Basin and on the sandier soils of towns farther away. The soil of both locations is less suited to vegetables than the soils of the original locations but is the nearest available land to the markets.

The apple industry has developed in the best available physiographic location and on the soils best suited to apple production, namely, the soils of the Charlton series. The adaptation of this belt to orchards is recognized by the orchardists, and the best orchards do not extend beyond it. It is fairly well recognized that the heavier terrace soils, Orono loam and Merrimac loam, are best adapted to the production of celery, lettuce, and cabbage. Merrimac sandy loam and Merrimac loamy sand are used extensively for the growing of asparagus and are generally considered the best soils for this crop. Merrimac fine sandy loam is used and fully recognized as the best soil for tuber and root crops, although these crops are grown on nearly all the soils in the county.

The cultural methods followed on the farms of Middlesex County vary considerably with the kind of farming practiced. On the dairy farms, silage corn and hay are grown as feed for cattle, almost to the exclusion of other crops. A number of dairymen buy at least 50 per cent of the feed used, and some buy nearly all, even using little or no pasture. On the market-garden farms, few crops other than vegetables are grown and a two-crop system is in general use. In the greenhouses, three crops are grown. On the poultry farms, small grains are grown for feed, but much of the feed is bought. Where orcharding is followed, most of the crops grown are used as cover crops. Many orchards are in sod. Smaller fruit trees, usually peaches, are used as fillers in apple orchards. Where general farming is followed, most of the staple crops are grown. The livestock consists of a few cows or a small dairy herd, a few hogs, chickens, and the work animals necessary on the farm. There is a small orchard, a garden for home use, or small patches of vegetables for market. The system of agriculture ranges from this form of general farming to specialized farming where everything is subordinated to the specialty.

Field corn is cut and shocked in the field, and sweet corn is used for stover after the green-corn season has passed. Corn harvesters are used on the larger farms, but most of the corn is cut by hand. The small grains are grown on such a small acreage that the crop is usually cut with mowers and cured for hay. In places, hay is stacked

and fed in the fields, but as a rule it is placed in barns after curing. Very little hay is baled. Timothy and clover are generally sown for hay, but on some farms orchard grass, Italian ryegrass, and redtop are used, and bluegrass or bent grass is added when pasturage is desired after the mowing fails. Some of the small grains are used as nurse crops for grass and clover. Alsike clover is sown on moist places. When the hay crop is short millet is sometimes sown late in the season and cut for hay. Millet, buckwheat, and rye are used as cover crops in orchards. Mowings are made until the hay grass begins to fail, then the field is pastured for an indefinite period.

Apples, at most of the large commercial orchards, are packed in barrels or boxes for market, but on the smaller farms they are sold in baskets or in bulk. Many roadside booths dispose of fruit and vegetables. The Nashoba Fruit Association has a packing plant near Littleton.

Two-horse turning plows are used on most farms, but on some the plows are larger. Two-horse cultivators and other implements are in common use, but on a few farms one-horse implements take their place. Tractors are used on many farms for breaking sod and for subsequent cultivations. The machinery, tools, and implements vary considerably with the type of farming carried on. Most of the farm buildings are good.

Table 5 gives the value of all farm property to the farm, as reported by the 1920 census:

TABLE 5.—*Value of all farm property to the farm in 1920*

All prop- erty	Land	Buildings	Imple- ments	Domestic animals
<i>Dollars</i> 11,289	<i>Per cent</i> 39.3	<i>Per cent</i> 43.7	<i>Per cent</i> 7.0	<i>Per cent</i> 10.0

Late in the fall the land is plowed to a depth ranging from 6 to 10 inches, depending on the seed bed necessary and the character of the land. The stony soils are not plowed so deep as are the stone-free soils. Land for market gardens is plowed 10 inches deep and the average farm land, where sod is turned, from 7 to 8 inches. In the spring the soil is harrowed or disked until it is in condition for seeding. Spring-tooth harrows are used on stony ground and disk harrows on other land. Orchard cultivation is started in early spring and continues until summer, when a cover crop is planted at the last working. In 1919, according to the 1920 census, 11,260 acres were in intertilled crops; 7,000 acres were in vegetables that require intensive cultivation; 6,355 acres in crops that require annual planting but no cultivation; 48,440 acres in mowing that requires seeding every five to eight years; and 1,623 acres in wild grasses that require no seeding. There were practically 10,000 acres in orchards, many of which are cultivated annually.

No systematic crop rotations are followed. On some farms, and it may be said to be a general practice up to a certain point, a rotation consisting of corn, first year, oats, second year, and grass, the third, fourth, and fifth years, is followed. However, the length of time

that the land remains in sod is indefinite and on some farms is so long a period of years that grass can not be said to be a part of a rotation. On many farms sod land is turned and grass sown with oats as a nurse crop. The land is pastured for many years after the mowing fails. Where market gardening is followed, the land is in vegetables season after season, the only changes being in the variety of vegetables grown. This varies with the individual grower to the extent that no definite system can be defined.

As reported by the 1920 census, 52 per cent of the farmers used fertilizers in 1919, with a total expenditure of \$530,397. Most of the dairymen and farmers who keep livestock use the manure on corn, grass, and vegetables. The market gardeners usually do not keep enough livestock to furnish manure, and they purchase from the dairy farmers, who grow few crops, and from livery and livestock barns in the cities. The market gardeners use manure in quantities ranging from 15 to 30 wagonloads to the acre. Where the supply is ample farmers use from 10 to 12 loads to the acre, but most of the land receives much less than that quantity and much of it receives none at all. The manure is spread on the surface during the winter. Liming is not a general practice. Most of the lime used is burnt lime and is applied to market-garden land at the rate of 1 or 2 tons to the acre every few years. On general farms it is applied at the rate of 1 ton to the acre after the sod is turned.

Commercial fertilizer is not in general use, only about half of the farmers reporting its use. It is largely used by market gardeners and fruit growers. The market gardeners use from 1,000 to 2,000 pounds to the acre of high-grade truckers' fertilizer or superphosphate (acid phosphate) and nitrate of soda. Orchardists use smaller quantities of basic slag, superphosphate, ground bone, kainit, and some nitrate of soda, sometimes in combination and sometimes separately. Superphosphate and the lower grades of fertilizer are used on farm crops.

In 1919, 90.1 per cent of the farmers reported the purchase of feed at an average cost of \$909.07 a farm. This feed consisted largely of grain bought for feeding work animals, dairy cattle, and chickens. Few farmers produce enough grain to carry the livestock through the winter, and many buy practically all the feed used.

Much of the farm work is performed by the farmer and his family, as labor is costly and scarce. In 1919, 63.4 per cent of the farmers reported to the census the hire of labor at an average expenditure of \$1,335.35 a farm. The dairymen, orchardists, and market gardeners use most of the hired labor. Workers in the dairies are fairly permanent, but those in the other industries are hired during the harvest season and when much hand work is required. Much of the efficient labor has been attracted away from the farms by the industries of the towns and cities of the region, where in many cases wages are higher. The price paid for the labor is \$3 to \$5 a day or from \$75 to \$100 a month.

The average size of the farms in Middlesex County has gradually decreased from 77 acres in 1880 to 57.8 acres in 1920. In 1920 there were 1,118 farms from 20 to 49 acres in size; 926 farms from 50 to 99 acres; 730 farms from 10 to 19 acres; 690 farms from 3 to 9 acres; 593 farms from 100 to 174 acres; 146 farms under 3 acres; 144 farms from 175 to 259 acres; 77 farms from 260 to 499 acres; 20 farms from 500 to 999 acres; and 2 farms over 1,000 acres.

In 1920, 87.9 per cent of the farms were operated by the owners. This figure is slightly lower than for 1880 but is slightly higher than for the last three decades. Only 6.2 per cent of the farms are rented. Of these, 239 are rented for cash, 17 for shares, 2 for share-cash, and 17 were not specified. Under the share rental system the owner receives one-half the crops and one-half the increase of animals. Cash rents are about 5 per cent of the farm value. Managers operated 5.9 per cent of the farms, which include estates, large orchards, market gardens, and dairies.

The average price of land, as given in the 1920 census, is \$76.75 an acre, an approximate increase of 35 per cent over 1910. The range of valuation extends from \$2 to \$6 an acre for the stony, rocky swamps to \$1,000 or \$1,500 an acre for desirable land near towns and cities. The prices for good terrace land for farming are from \$100 to \$300 an acre, but for areas located advantageously for building lots the price is higher. The prices for good drumlin land are from \$100 to \$250 an acre; for good till land free from stone from \$100 to \$250 an acre; for average stony till land from \$30 to \$50 an acre; for sprout land from \$20 to \$35 an acre; and for pasture land from \$20 to \$50 an acre. The price of forested land is determined to a great extent by the size and condition of the timber.

In this county the location probably has a greater effect on the value of the land than any other single factor, but the kind of soil controls the price to a marked extent where land is located away from the zone of building activity.

SOILS

The soils of the well-drained uplands of Middlesex County have, in their virgin state, a surface covering, in most places 1 inch or more thick, of leaf litter and mold over a thin layer of finely divided organic matter. This rests on a dark grayish-brown or rust-brown layer 6 or 8 inches thick, which passes gradually into the subsoil, the upper part of which is deep yellowish brown or some shade of yellow. This material becomes paler with depth and passes finally, at a depth of about 2 feet, into the unweathered parent material or substratum. In places there is a thin, light-gray layer between the surface layer of organic matter and the brown mineral layer. The striking feature of this soil profile is the vertical color variation or banding, unaccompanied by marked and consistent texture changes.

Few of the well-drained soils are weathered deeper than 2 feet. Only a very small part of even the feldspathic and ferro-magnesian minerals have decomposed into clay, and consequently there is no marked accumulation of fine material within the weathered zone. The incomplete decomposition of the soil minerals is due in part to the cool climate of the region but to a greater extent to the short time since the material was accumulated by glacial ice and accompanying waters. The effect of the humid climate is shown in the absence of soil carbonates and the effect of forest cover in the very low percentage of organic matter in the well-drained soils.

In small, poorly drained areas, the soils have dark topsoils and gray, or mottled yellow, brown, and gray subsoils. In some soils, particularly on the drumlins, is what is termed locally hardpan. This is, however, a compact layer in the original glacial drift.

Middlesex County lies in the glaciated region, and the soil material has been accumulated by glacial agencies. The soil material or parent glacial deposit is similar in petrographic character to the basal rock formation, and even though boulder trains can be traced for long distances, the bulk of the soil material was deposited a short distance from its place of origin. The glacial drift deposit ranges from a film to a layer 100 feet thick. The depth of weathering of the glacial material is determined to some extent by the character of the material, that with the highest percentage of ferro-magnesian minerals or of shales having weathered to the greatest depth. The prevailing textures are fine sandy loam, sandy loam, and loam and each has its stony counterpart.

The soils of the county are classified in series, the soils of each series having developed from material of the same kind and accumulated by the same process, under the same drainage conditions. The soils of a series are similar in color, structure, and arrangement of the soil layers. The series are further divided into soil types, the unit of soil mapping, on the basis of texture or the proportion of sand, silt, and clay in the surface soil.

The soils of the county were classified in 14 soil series, including 41 soil types and 10 phases, and in 5 miscellaneous classifications of land, including rough stony land, muck and peat, meadow, tidal marsh, and made land.

The soils of the Gloucester series have brown topsoils and yellowish-brown subsoils that become paler with depth and grade, at a depth of about 2 feet, into the gray, unweathered, light-textured, drift parent material. There is no marked textural profile. The soils are derived mainly from granite and gneiss material. They occur on well-drained uplands and carry a noticeable quantity of rounded and subangular stone. The loam, stony loam, very stony loam, fine sandy loam, with a gravelly phase, stony fine sandy loam, with a gravelly phase, sandy loam, stony sandy loam, with a gravelly phase, and stony loamy sand members of the Gloucester series were mapped.

The soils of the Coloma series have, in general, soil profiles similar to those of the Gloucester soils. They are derived from highly quartzose sandstone, shale, and conglomerate. The loam, with a stony phase and a gravelly phase, fine sandy loam, with a stony phase, and sandy loam, with a gravelly phase, members of the series were mapped in this county.

The soils of the Charlton series have brown topsoils, brown or yellowish-brown subsoils, and a fairly compact heavy substratum below a 20-inch to 24-inch layer of gray or greenish-gray unweathered till. These soils differ from the Gloucester soils mainly in having heavy, compact substrata. They are, in general, freer from stones than the Gloucester soils and are derived from deeper glacial deposits. The fine sandy loam, stony fine sandy loam, sandy loam, stony sandy loam, loam, and stony loam members of the series were mapped in this county.

The Brookfield soils have reddish or rust-brown topsoils, ocherous-yellow or brown subsoils, and mealy, pale ocherous-yellow or greenish-yellow substrata. The parent material is comparatively shallow drift derived largely from the Brimfield schist. These soils are closely associated with the Charlton soils but differ in having lighter-

textured subsoils, redder topsoils, and in being derived from thinner drift. Brookfield loam, Brookfield stony loam, and Brookfield stony sandy loam were mapped.

The Paxton soils have brown topsoils, greenish-yellow, fairly firm and compact subsoils, and greenish-gray heavy compact till below a depth varying from 20 to 24 inches. They occur as drumlins or in drumloid forms, as fairly deep deposits containing few stones. They are derived from a mixture of material, mostly schist and phyllites. The loam, with a stony phase, and gravelly loam members of this series were mapped.

The soils of the Dutchess series have much the same soil profile as those of the Paxton. They occur on drumlins but are derived almost entirely from slate material. Dutchess slate loam was mapped in this county.

The Hollis soils have brown topsoils, yellowish-brown subsoils, and greenish-yellow or greenish-gray substrata below a depth of about 24 inches. The subsoils, in comparison with those of the Charlton soils, are light in texture. The glacial drift is comparatively shallow, as the partly disintegrated bedrock is found in many places within 3 feet from the surface. The parent drift is derived from schist and phyllite. Hollis loam, Hollis stony loam, and Hollis fine sandy loam were mapped.

The topsoils of the Bernardston soils are darker than those of most of the upland soils. The subsoils are greenish yellow, and weathering has taken place to a depth of 2 feet. The substrata are greenish-gray, fairly compact, heavy till, mostly phyllite. Bernardston silt loam, with a stony phase, was mapped.

The soils of the Whitman series have dark-brown or almost black topsoils, deeper than the average for the county. The subsoils are gray or grayish brown, mottled with yellow and brown below a depth of 20 inches, and the substrata are gray below a depth of 26 or 28 inches. These soils occur in low, poorly drained areas in the uplands, usually in association with the Gloucester soils. Whitman loam and Whitman stony loam occur in Middlesex County.

The Hinckley soils have brown topsoils and yellowish-brown subsoils that become paler with depth and finally grade into a gray mixed sand and gravel substratum lying about 2 feet below the surface. They are derived from light-textured glacial drift material which occurs as kames, eskers, and moraines. Hinckley gravelly sandy loam, with a dark-colored phase, Hinckley stony loam, and Hinckley loamy sand were mapped.

The soils of the Merrimac series have brown topsoils and yellowish-brown subsoils which become paler with depth. The substratum, below a depth of about 2 feet, is gray sand and gravel commonly found in stratified beds of fairly well assorted material. These soils are derived from water-laid glacial material. The sandy loam, loamy sand, fine sandy loam, gravelly loam, gravelly sandy loam, and loam members of the series occur in this county.

The soils of the Orono series have dark-brown, rather deep topsoils and greenish-yellow, firm subsoils mottled faintly with brown.

Below a depth of 2 feet, the subsoils are greenish-gray or gray heavy mottled clay. The deeper part of the subsoil is calcareous. Orono loam was mapped.

The Sudbury soils have dark topsoils and yellowish-brown subsoils which become pale yellow or pale greenish yellow below a depth of 15 inches. The substratum, below a depth of 30 inches, is lighter in texture and structure than the upper layers and is mottled yellowish brown, brown, greenish yellow, and gray. These soils may or may not be of glacial origin. Sudbury loam was mapped.

The soils of the Ondawa series have brown topsoils and yellowish-brown subsoils which become paler with depth and finally merge, at a depth ranging from 24 to 30 inches, with a gray or pale yellowish-gray substratum of the same structure and texture as the upper layers. The deeper part of the subsoil is commonly mottled with brown. Ondawa fine sandy loam was mapped.

Meadow is a classification applied to first-bottom overflow land that has little or no consistent texture. The topsoil is dark brown or black and is inclined to be mucky. The subsoil is gray or dark gray mottled with brown, rust brown, or yellow. The substratum is invariably gray or light gray in color and varies from sand to clay in texture. Areas are level and lie low enough to receive frequent inundations.

Muck and peat include all organic soils more than 18 inches thick. Muck consists of black, well-decomposed organic matter mixed with some soil material, underlain by brown or dark-brown, partly decomposed organic matter. This is underlain, at a depth of less than 4 feet, by a sandy substratum. The peat deposits are commonly deeper and consist of a mass of brown, fibrous, partly disintegrated plant remains.

Tidal marsh is a classification that is applied to the low, marshy flats which are covered or partly covered by water at high tide. It commonly consists of heavy-textured material, gray with mottles of brown. It is highly impregnated with salt and is poorly drained.

Rough stony land includes all land too steep and stony for profitable farming operations. The stone, in most places, is granite or associated crystalline rock, but the other rocks of this region are present in places.

Made land consists of the areas of tidal marsh and swamp that have been filled in with debris from the adjoining towns and cities.

Although a large number of soils were mapped in Middlesex County, only a comparatively small number are extensive or of the character to make them suitable for the development of agriculture. Many are stony, poorly drained, or droughty. Most of the land under cultivation consists of sandy loams, fine sandy loams, and loams of the Gloucester, Coloma, Charlton, Brookfield, and Paxton series, and of the heavier Merrimac soils. The remaining soils are but little used for farming purposes.

In the following pages of this report the different soils are described and their agricultural importance is discussed; the accompanying soil map shows their distribution; and Table 6 gives their acreage and proportionate extent.

TABLE 6.—*Acreage and proportionate extent of soils mapped in Middlesex County, Mass.*

Type	Acres	Per cent	Type	Acres	Per cent
Gloucester loam.....	7,232	1.4	Brookfield stony loam.....	2,752	0.5
Gloucester fine sandy loam.....	11,648	2.7	Brookfield stony sandy loam.....	1,216	.2
Gravelly phase.....	2,624		Barnardston silt loam.....	2,304	.9
Gloucester sandy loam.....	11,584	2.2	Stony phase.....	2,624	
Gloucester stony loam.....	9,088	1.7	Hollis loam.....	2,496	.5
Gloucester stony fine sandy loam.....	51,904	11.8	Hollis stony loam.....	1,856	.4
Gravelly phase.....	11,008		Hollis fine sandy loam.....	3,904	.7
Gloucester very stony loam.....	832	.1	Whitman loam.....	960	.2
Gloucester stony sandy loam.....	30,784	6.7	Whitman stony loam.....	5,568	1.0
Gravelly phase.....	4,672	2.3	Hinckley gravelly sandy loam.....	31,296	6.0
Gloucester stony loamy sand.....	12,352		Dark colored phase.....	704	
Paxton loam.....	1,280	.4	Hinckley loamy sand.....	10,048	1.9
Stony phase.....	1,088		Hinckley stony loam.....	5,696	1.1
Paxton gravelly loam.....	1,792	.3	Merrimac sandy loam.....	27,136	5.1
Charlton loam.....	3,840	.7	Merrimac fine sandy loam.....	20,544	3.9
Charlton stony loam.....	3,904	.7	Merrimac loam.....	2,560	.5
Charlton fine sandy loam.....	2,304	.4	Merrimac loamy sand.....	46,720	8.8
Charlton stony fine sandy loam.....	2,240	.4	Merrimac gravelly loam.....	8,896	1.7
Charlton sandy loam.....	2,432	.5	Merrimac gravelly sandy loam.....	17,344	3.3
Charlton stony sandy loam.....	2,304	.4	Orono loam.....	3,136	.6
Coloma loam.....	3,200	.8	Sudbury loam.....	2,560	.5
Stony phase.....	576		Ondawa fine sandy loam.....	7,040	1.3
Gravelly phase.....	128	.3	Meadow.....	17,472	3.3
Coloma sandy loam.....	448		Muck and peat.....	80,704	15.2
Gravelly phase.....	1,280	.4	Tidal marsh.....	960	.2
Coloma fine sandy loam.....	1,664		Made land.....	896	.1
Stony phase.....	384	.7	Rough stony land.....	38,016	7.1
Dutchess slate loam.....	3,776	.1			
Brookfield loam.....	704		Total.....	532,480	

GLOUCESTER LOAM

Where forested Gloucester loam has a surface covering, about 1 inch thick, of leaf mold. This rests on dark-brown mellow light loam, 1 or 2 inches thick, which grades into light-brown light loam or heavy fine sandy loam which continues for 2 or 3 inches before it grades into the subsoil. In cleared areas the soil, to a depth of 6 or 8 inches, is dark-brown light loam or heavy fine sandy loam underlain by yellowish-brown, friable, medium-textured loam. At a depth of 18 or 20 inches, the subsoil grades downward into yellow, slightly compact loam or sandy loam. This in turn grades, at a depth ranging from 24 to 30 inches, into gray, unweathered, slightly compact sandy till which continues to bedrock. Some gravel, small stones, and sub-angular boulders are scattered on the surface and throughout the entire soil. Fewer stones were on this land in its virgin state than on the other Gloucester soils. Most of the loose stones have been piled into fences that surround the fields. The stones are predominantly granite and gneiss.

Gloucester loam was formed by the weathering in place of glacial drift derived largely from crystalline rocks. The drift ranges in thickness from 5 to 20 feet and rests, in most places, on granite and gneiss bedrock. Weathering has taken place to an average depth of 2 feet.

This soil is widely scattered over the county. It occurs mainly in the towns of Holliston, Sherborn, Hopkinton, Natick, and Billerica, in the northern parts of Dracut and Tewksbury, and in other small scattered areas.

Areas are typical of a smoothly glaciated region. The soil occurs on hilltops where the glacial drift is thick enough to cover the larger stones that rest on the bedrock. The slope is gentle from the crests

of the hills, and the deep drift commonly terminates at the break of the hill. However, in a few places, the mantle extends down the hillside to the bottom. The drainage, though internal, is well established. The land holds moisture well, and crops rarely suffer from lack of moisture, even in dry seasons.

Gloucester loam is one of the most important soils agriculturally in the county. Between 70 and 80 per cent of it is cleared and used for farming. The remainder is forested with second-growth hardwoods consisting mainly of oak and chestnut, with some birch, maple, and white pine. Practically all of this land has been cultivated at some time since the first settlement of the county. Most of the cleared land is in mowing, but a small area is in permanent pasture and a comparatively small acreage is in cultivated crops. Aside from hay (timothy), silage corn and oats are the most important field crops. Sweet corn, potatoes, rye, and clover are grown on smaller acreages. Market gardening is carried on to a small extent. Practically every farmer has a small garden and orchard and the complement of animals found on most farms of this county. Several commercial apple orchards are on this soil. Most of the home orchards contain peaches and pears in addition to apples. Several large dairies are located on this soil, and a few farmers make a specialty of chickens.

Crop yields are usually good, averaging probably better than on any of the other Gloucester soils and comparing favorably with those obtained from any soil in the county. Hay (timothy) yields from 1 to $2\frac{1}{2}$ tons to the acre, corn (grain) from 25 to 60 bushels, corn (silage) from 10 to 15 tons, oats from 20 to 40 bushels, and potatoes from 75 to 150 bushels. Clover makes a good stand, especially where the soil is limed. Apple trees make a healthy growth and bear heavily. Vegetables, such as cabbage, beans, and turnips, give good returns.

Gloucester loam is farmed as well as any soil in the county that is used for general farming. Timothy and clover or timothy alone are used for mowing, and when the timothy fails the land is used for pasture for indefinite periods. Only comparatively small quantities of commercial fertilizer are used, manure being depended on, in the main, to keep up fertility.

This land is highly desirable for farming, as it occurs in large areas in smooth, open country. The price ranges from \$50 to \$250 an acre. Good average farm land of this type sells at prices ranging from \$100 to \$150 an acre.

Gloucester loam, like most of the soils of this county, is sour, and from one-half to 1 ton of burnt lime to the acre should be used, especially where clover is to be grown. The soil is adapted to general farming, fruit growing, market gardening, dairying, and stock raising.

GLoucester FINE SANDY LOAM

In forested areas of Gloucester fine sandy loam, a surface covering, 1 inch or more thick, of leaf litter and mold rests on a dark-brown or dark grayish-brown layer from one-half to 1 inch or more thick. This layer grades into grayish-brown, mellow fine sandy loam which continues to a depth of 10 or 15 inches. Below this depth is pale yellowish-brown material which, at a depth of 20 or 24 inches, becomes pale

yellow and grades below into gray, unweathered drift, lighter in texture than the upper layers. In places under forest cover where the soil has not been disturbed, a very thin gray layer separates the leaf mold from the upper mineral layer. In cultivated or cleared fields the topsoil is dark-brown or brown fine sandy loam underlain by the typical yellowish-brown subsoil. This soil is unusually consistent in occurrence. A noticeable quantity of the parent rock, granite and gneiss, is on the surface and throughout the soil and substratum. This rock consists of gravel and boulders of different sizes, partly rounded and subangular.

Gloucester fine sandy loam occurs on smoothly rolling uplands. Drainage, which is largely internal, is good.

This soil is most extensive in scattered areas over the southeastern part of the county, but isolated areas occur in nearly every part.

Gloucester fine sandy loam is one of the important soils of the county. Practically all of it has at one time been under cultivation, and at present fully 60 per cent is used for farming. The remainder is covered with a second-growth forest of hardwoods, in which oak and chestnut predominate. A few scattered white pine are also present. At least 10 per cent of the cleared land is occupied by buildings; about 75 per cent is in mowing; and the rest is planted to corn (silage and sweet), oats, market-garden crops, and orchards. Small home orchards, mostly of apples, are found on the soil, and commercial apple orcharding is developed in the west-central part of the county. Market gardening is important mainly in the eastern part. Cabbage, beans, turnips, and squash are commonly grown. Dairying is developed to some extent on this soil in nearly all parts of the county. Little of the land is utilized for pasture, except where the mowings are grazed. Aside from hay, silage and sweet corn occupy the largest acreage of any crops.

Hay yields about 1 ton to the acre in an average season but falls far short of this during droughts. Field corn yields from 25 to 60 bushels to the acre, depending on the fertilization and the season. Silage corn cuts from about 7 to 10 tons to the acre, the yields usually being good because of the large quantity of manure applied. Oats do fairly well. The staple market-garden crops of this region give fairly good returns where they are highly fertilized. This land furnishes excellent orchard sites, and orchards are successful where they are properly managed and fertilized.

The agricultural methods are essentially those described under the chapter on agriculture. The usual rotations are followed and are adjusted, as on the other soils, to suit the type of farming. Fertilizers are used to a small extent, except on orchards and market-garden crops which receive unusually heavy applications.

Gloucester fine sandy loam currently sells for prices ranging from \$75 to \$200 an acre, depending on the location and improvements. Areas close to cities are held at a very high price, although the land is utilized for farming. Some of the estates located on this soil are valued far beyond their agricultural value.

Most of this soil is deficient in organic matter which must be supplied either from barnyard or green manures. Where dairying is practiced, this presents no difficulty, but in other forms of farming it is a problem to be met by growing more clover and other legumes in

rotation. Liming may be necessary to grow clover, as this soil is strongly acid. Applications ranging from 1 to 2 tons of burnt lime to the acre in each rotation should be sufficient. Lime should be applied where market-garden crops are grown, to obtain the best results from the fertilizer used. This land, although light, is well suited to apples. Where dairying is followed, more silage corn could well be produced. On the higher-priced areas of this soil it is doubtful if anything but intensive market gardening will be found profitable.

Gloucester fine sandy loam, gravelly phase.—The soil of the gravelly phase of Gloucester fine sandy loam is very similar to the typical soil, with the exception that the phase carries a much larger quantity of gravel scattered on the surface and throughout the soil and substratum. The gravel consists of blocky and partly rounded pieces of crystalline rocks, ranging in diameter from 1 to several inches. There is evidence that this soil carried a considerable quantity of gravel on the surface in its virgin state, and there is also little doubt that continued cultivation has resulted in the removal by erosion of the finer particles, leaving a comparatively higher proportion of gravel on the surface. The gravel does not interfere materially with cultivation and may possibly be an aid to conserving moisture. Areas are smooth, and drainage is as good as on the typical soil.

This soil occurs in the eastern part of the county, in small scattered areas in the towns of Natick, Waltham, Arlington, Lexington, Woburn, and Melrose.

Gloucester fine sandy loam, gravelly phase, is used for the same crops as the typical soil, but owing to its location more market gardening is carried on. These areas are, in general, better farmed than the rest of the soil.

Owing to the location of this land current prices are high, ranging from \$250 to \$500 an acre.

GLOUCESTER SANDY LOAM

In forested areas, the topsoil of Gloucester sandy loam has a covering, about 1 inch thick, of leaf mold, resting on a thin layer of gray material. This grades abruptly into dark yellowish-brown, mellow sandy loam which continues for 2 or 3 inches before becoming light yellowish brown in color. In cleared areas the soil, to a depth of 6 or 8 inches, is brown, mellow sandy loam, which grades into the subsoil of yellowish-brown, friable sandy loam. The subsoil becomes lighter in color and texture with depth and finally grades, at a depth of 15 or 20 inches, into pale-yellow, light sandy loam and at a depth of 24 inches into gray, partly weathered drift which changes, at a depth ranging from 30 to 36 inches, to gray, coarse, sandy, unweathered drift. Some subangular and rounded boulders of granitic rock are scattered on the surface and throughout the soil and substratum.

Gloucester sandy loam is the weathered surface of a comparatively thin glacial-drift deposit derived mainly from coarse-grained granitic and gneiss rocks. The drift ranges from 1 foot to 20 feet in thickness. In a few places the bedrock comes very close to the surface.

This soil occurs on smooth hilltops, somewhat flattened ridges, and gently sloping hillsides. The drainage is excellent. The soil is not extensive, being found only in the northern part of the county where

it occurs in scattered, oval-shaped areas on hills and ridges on the sides of which is Gloucester stony sandy loam. Most of this land occurs in Townsend, Ashby, Chelmsford, and Dracut Towns.

Although not extensive, this is one of the important soils, as it represents the best farming land in the region in which it occurs. Nearly all of it is cleared and used for farming. The timber consists mainly of oak, chestnut, maple, and white pine. Most of the cultivated land is in mowing and pasture. The small cultivated area is devoted to corn, oats, rye, and buckwheat, and patches of sweet corn and potatoes. A few commercial apple and peach orchards are located in Chelmsford Town.

Hay (timothy), the most important crop, yields from one-half to $1\frac{1}{2}$ tons to the acre, depending on the season and seeding conditions. In dry seasons, the yields are lower than on some of the heavier soils. Fairly good yields of the other crops are obtained, but they run consistently lower than on the fine sandy loam or loam of the series, owing in part to the low productive power of this soil and to the generally better farming practices on the other soils.

Gloucester sandy loam currently sells for prices ranging from \$30 to \$100 an acre, depending on the location and character of the timber. The average price of farmed areas of this soil is \$50 an acre, excluding the value of buildings.

Most of this land is deficient in organic matter, and measures should be taken to overcome the deficiency. This may be accomplished by turning under sod land or cover crops or by increasing the number of animals so that a larger quantity of manure will be available.

GLoucester STONY LOAM

In forested areas Gloucester stony loam has a surface layer, 1 inch or more thick, of dark or almost black leaf mold, resting on dark-brown loam which is underlain by light-brown loam which continues to a depth of 4 or 5 inches. In cleared areas the soil, to a depth of 7 or 8 inches, is dark-brown, mellow light loam. The subsoil and substratum are essentially the same as in Gloucester loam. Stone fragments and boulders, ranging in diameter from a few inches to several feet, are scattered on the surface and throughout the soil and substratum. These occur in the surface soil in such quantities as to seriously interfere with cultivation. The soil consists of glacial drift derived mainly from granite and gneiss.

This soil is widely distributed, occurring chiefly on the hills throughout the central part of the county in the towns of Framingham, Hudson, Maynard, Acton, Concord, and Carlisle, and in scattered small areas in adjacent towns. Areas are gently or steeply sloping and hilly, the soil occurring in many places as drumlin and drumloid forms. The drainage is well established, except in small seepage areas along the hillsides.

This soil is not important in the agriculture of the county at the present time. About 60 per cent of it is in forest, which consists of second-growth oak, chestnut, birch, and maple, and some white pine. A considerably larger total area was under cultivation at one time but has been allowed to grow up in brush and forest. Many of these areas were in pasture and were gradually abandoned as they became covered with brush. The cleared areas are in mowing and pasture, with a

small area in cultivated crops. Permanent pastures occupy more than 50 per cent of the cleared area, but these contain much brush, principally sweet fern, hardhack, blueberries, and sumac. The crops grown on Gloucester loam are also grown on this soil but the acreage of intertilled crops is almost negligible. Commercial orcharding is a minor industry in Acton and Maynard Towns. Although some of the commercial orchards are good and small orchards are found on each homestead, the soil, in general, is not used for orcharding. A number of dairy cattle and some sheep are pastured on this land. Each farmer has a small patch of sweet corn, potatoes, and vegetables.

This soil is fairly strong, and the acreage yields compare favorably with those of the other Gloucester soils. The stones are the chief drawback and present the main difficulty in managing intertilled crops. Where any attempt has been made at cultivation, many of the loose stones have been removed.

The current selling price of this soil ranges from \$25 to \$75 an acre, with some of the better-located and improved farms selling for as much as \$100 an acre.

Much of the pasture land that has grown up in brush could be reclaimed at a comparatively low cost. These areas could be used to advantage for grazing dairy cattle, as the soil furnishes good grass. It is doubtful if it would repay the cost of removing the stones to the point that it could be easily cultivated. This land can best be utilized for pastures and orchards.

GLOUCESTER STONY FINE SANDY LOAM

Gloucester stony fine sandy loam is similar throughout to Gloucester fine sandy loam, except that large quantities of partly rounded and subangular boulders and gravel of the parent rock material are present on the surface and embedded in the soil and substratum.

The formation from which this soil is weathered is comparatively thin glacial till derived largely from granite and gneiss. Ledges and protrusions of the bedrock occur in places but are not common, most of the bedrock being covered with the glacial drift to a depth ranging from 2 to 20 feet.

Gloucester stony fine sandy loam is an extensive soil, occurring in fairly large, irregular areas throughout the upland of the central and southern parts of the county. Areas of this soil are rolling or hilly and sloping. Some of the run-off from rainfall is through surface channels, but much of the drainage is internal. Drainage is well established throughout, except in a few small included poorly drained areas of a Whitman soil and in a few small areas on slopes and hillsides which receive seepage water.

Only comparatively small areas of this land are cleared and cultivated. Most of the cleared area is in pasture, which is probably 50 per cent or more sweet fern and hardhack. The timber consists of second-growth oak, chestnut, and birch, with some white pine in places. The cultivated fields are in mowing (timothy), in some small fields of sweet corn, and in garden crops. Apple orchards, some of which are good considering the difficulty attendant upon cultivation and care, are found on this land in the west-central part of the county.

A much larger total area of this soil formerly was used for farming but was abandoned during the era of agricultural retrenchment.

This land is utilized at the present time for crops which require hand cultivation in locations close to markets.

Crop yields are slightly less than on Gloucester fine sandy loam, for the reason that the land is more difficult to cultivate. The difficulty in using machinery or improved farm implements has forced much of this land into pasture.

If the rocks were removed, this soil would be practically the same as Gloucester fine sandy loam, could be used for the same crops, and could be improved by the same methods. However, the cost of removing the stones would be higher than the crop returns would warrant, except in places very close to markets and where land values are very high. The selling price varies considerably with the location.

Gloucester stony fine sandy loam, gravelly phase.—Gravelly Gloucester stony fine sandy loam differs from the typical soil only in having a higher proportion of gravel in the topsoil and possibly in the subsoil and substratum. The gravel consists of blocky, subangular, and rounded granite, felsite, and similar rocks.

Much of the coarser gravel and the stone has been taken from the fields and piled in heaps at the corners or around the edges. The gravel probably would not have interfered with cultivation under ordinary field methods, but this land was cleaned of stones and gravel for market-garden crops.

The surface features and drainage are similar to those of the typical soil.

The gravelly phase of Gloucester stony fine sandy loam occurs in extensive areas in the southeastern part of the county, in the towns of Waltham, Lexington, Arlington, Burlington, Winchester, Woburn, Melrose, Stoneham, and Wakefield. It covers most of the hill region of these towns.

This soil is used extensively for market-garden crops. The other crops grown are the same as on the typical soil. The methods followed on the market-garden farms are the same as where these crops are grown on Gloucester fine sandy loam.

Because of the location of this soil much more of it is cleared than of the typical soil, and it is held at much higher prices.

GLoucester Very Stony Loam

Gloucester very stony loam is very similar to Gloucester stony loam or Gloucester fine sandy loam, except that the very stony loam carries a larger quantity of stones. The glacial deposit composing the soil is shallow, bedrock cropping out in numerous places. This soil is intermediate between Gloucester stony loam and rough stony land. It occurs on hills and ridges rising higher than the surrounding country and on some of the steeper slopes where the smoother land is Gloucester fine sandy loam or Gloucester stony fine sandy loam. Areas range from gently rolling to steep, hilly, and broken. The drainage, like that of the other Gloucester soils, is good, and in places is inclined to be excessive, although seepage on some of the hillsides has a tendency to offset the rapid surface run-off of the steeper slopes.

Gloucester very stony loam is not extensive. It occurs exclusively in small scattered areas in the southern part of the county, mainly in the towns of Weston and Sherborn. It is not important agriculturally, being little used for farming. Some pastures contain much

brush, principally sweet fern, sumac, and gray birch. The forest growth consists of oak, chestnut, and birch, with scattered white pine and a thick underbrush of huckleberry and associated shrubs.

Cut-over areas of this soil sell between \$10 and \$20 an acre, or less, but higher prices are obtained where there is merchantable timber or rock suitable for quarrying.

This land, in its native state, can be utilized for pasture for goats and sheep. Where it has been cleared and has grown up in brush it might be feasible to clear it for open pasture, especially where it is located on dairy farms. In most areas too large a proportion of the stone consists of bedrock and large bowlders to make clearing practical even for pasture.

GLOUCESTER STONY SANDY LOAM

In forested areas Gloucester stony sandy loam has a covering of leaf mold about 1 or 1½ inches thick, resting on a brown sandy layer which continues for 1 inch or more and passes into yellowish-brown sandy loam. In cleared fields the soil is dark-brown mellow sandy loam, underlain at a depth of 6 or 8 inches by yellowish-brown friable sandy loam which becomes lighter in color and texture with depth, becoming pale yellow at a depth of 15 or 20 inches and finally passing, at a depth of 2 feet, into gray partly weathered drift. Below a depth of 3 feet the substratum is gray, coarse sandy drift. The surface is strewn with fragments of the parent-rock material ranging from pebbles to large rounded and subangular bowlders. These stones are also embedded in the soil and throughout the entire deposit that gives rise to it, and in many places the bedrock is exposed or is only a few feet below the surface. The deposit is thin glacial drift derived from coarse-grained granite and gneiss.

This soil occurs on hills and ridges with steeply sloping or gently sloping sides. Drainage is almost entirely internal and is well established, due both to the surface features and to the coarse texture of the substratum. This soil is extensive over the central part of the county, in the northern part, and in the northwest corner, large areas being found in Ashby, Townsend, Dunstable, Tyngsborough, Tewksbury, Reading, Bedford, Carlisle, Concord, Sudbury, and Billerica Towns, and a few scattered areas occurring in other towns.

Gloucester stony sandy loam is fairly important agriculturally, considering its extent. Between 60 and 70 per cent of it is in forest, which consists mainly of second-growth oak, chestnut, birch, maple, and other hardwoods, with some white pine and spruce in the northwestern corner of the county. The cleared areas are used largely for pasture. The pastures contain considerable sweet fern and blueberries. A much larger area of this land was in pasture at one time but was gradually abandoned as it became filled with brush and grew up in birch and other trees. Owing to the difficulty of handling implements in the stony ground only comparatively small areas are in cultivated crops, mainly grass (hay), corn (silage), oats, and rye. Some orchards appear to be in good condition. A number of dairies are located on this soil in the Lowell district, but dairy farmers utilize it mainly for pasture and depend on other soils for the forage and silage necessary for feed. A number of hogs are kept on some farms where the woodland is used for pasture. Small patches of sweet corn, potatoes, and vegetables, and small orchards are found on most of

the homesteads. Crop yields are slightly less than on Gloucester sandy loam.

Where attempts have been made to cultivate this land, many of the loose stones have been put into fences surrounding the fields, but many stones are still on the ground. The stone content is the chief drawback to cultivation and has been the cause of the abandonment of many farms and fields.

The current selling price of this soil ranges from \$15 to \$75 an acre, depending on the location and condition of the soil. In forested areas the timber is the determining factor. Cut-over land is held at a low price, except areas close to towns.

The abandoned pastures on this soil could be reclaimed without great expense and could be profitably utilized in dairying. Where cultivation is undertaken, more of the stone should be removed. The methods for improvement recommended for the fine sandy loam and sandy loam members of the Gloucester series apply also to this soil. This land could be used for apple and peach orchards, especially the latter. Like the other Gloucester soils, it is acid and in need of lime. Where it is to be pastured this is not a serious drawback, but where clover sod is desired liming with about one-half or 1 ton of burnt lime to the acre is necessary. Some of this land can well remain in forest.

Gloucester stony sandy loam, gravelly phase.—Gloucester stony sandy loam, gravelly phase, has a soil and substratum identical with those of the typical soil except that the proportion of gravel is probably from 10 to 20 per cent greater. The gravel consists of rounded subangular and blocky pieces of granitic rock and diorite, from 1 inch to 4 inches in diameter, and occurs on the surface and scattered throughout the entire soil and substratum.

This phase of soil is not widely distributed but occurs in fairly large areas in the towns of Lexington and Burlington. It is held at a slightly higher price than the typical soil, on account of its location. Much of it is forested. The small area cleared is used for pasture on dairy farms and for market-garden crops. Most of the work in the small patches of vegetables is done by hand.

GLOUCESTER STONY LOAMY SAND

In most places in forested areas of Gloucester stony loamy sand a light covering of leaf mold is underlain by a dark-brown layer about 2 inches thick. This layer passes into light-brown loamy sand which continues to a depth of 5 inches, where it grades into yellowish-brown loamy sand. Below a depth of 15 or 20 inches is pale-yellow material, and below a depth of 24 inches is gray sandy till, extremely open in structure. In cleared areas the soil, to a depth of 5 or 6 inches, is brown loamy sand grading into yellowish-brown loamy sand, fairly loose and open in structure. A noticeable quantity of subangular and rounded granitic boulders of different sizes are scattered over the surface and through the topsoil, subsoil, and substratum.

The parent material is glacial drift derived from granitic rocks and in most places is mixed with sandy outwash material. The surface features are those of a typical glacial region, the soil occurring on low hills and ridges and along the lower slopes of the hills. The drainage, although largely internal, is well established, and the soil is inclined to be droughty in dry seasons.

This land although widely distributed through the northern and western parts of the county, does not have a large total area. It occurs in comparatively small areas, the largest being in the towns of Billerica, Tewksbury, Wilmington, and Reading. Scattered areas are in Carlisle, Chelmsford, Dracut, Tyngsborough, Dunstable, and Townsend Towns, and along the Sudbury-Marlboro line. Most of it is covered with second-growth forest which consists of considerable scrub oak, gray birch, white pine, and, in places, pitch pine. Some areas are grown up with oak and chestnut. Nearly all the cleared area is in pasture, which in many places is covered to the extent of 50 per cent or more with brush. Even where the brush is kept down grazing is poor.

This is not a strong soil, and in most places it could be best utilized for forest.

PAXTON LOAM

In forested areas the topsoil of Paxton loam is dark brown to a depth of 1 or 2 inches. This dark layer is underlain by brown material which changes to yellowish-brown, pale-yellow, or greenish-yellow loam within a depth of 5 inches. In cleared areas that have been under cultivation the soil is brown or dark yellowish-brown loam which grades, at a depth of 6 or 8 inches, into yellowish or greenish-yellow, fairly heavy but friable loam. This continues to a depth of 20 inches below the surface, where it is underlain by a compact, greenish-gray or pale greenish-yellow layer, slightly heavier than the upper part of the subsoil. The substratum, below a depth ranging from 24 to 30 inches, is tightly compact greenish-gray unweathered drift, lighter in texture than the subsoil and containing, in places, a noticeable quantity of coarse sand. The entire soil contains some gravel, especially in the compact layer 20 inches below the surface. This layer, although compact and known locally as hardpan, does not prevent the downward movement of water. Recurrent beds of gravel are present in the substratum, but the soil carries only a small proportion of stones scattered on the surface and throughout. The stones consist of small fragments of schist and a few boulders of granite. In places a noticeable quantity of slate chips is present.

In a few small areas of this soil the topsoil is fine sandy loam or light loam, but the subsoil is even heavier than in the remainder of the soil. These small areas are in the western part of Framingham Town and in Dunstable Town.

Paxton loam occurs almost exclusively on drumlins in the north-western part of the county, in a belt that passes southward through Worcester County. Most of these drumlins are in Ashby and Shirley Towns. The hills are oval, with the long axis pointing north and south.

This soil is derived from the weathering of glacial drift composed of schist, phyllite, and other crystalline rock material that has been piled by the glacier into drumlin and drumloid forms. The drainage is well established, although seepage water is found in many spots on the hillsides. The soil has an excellent moisture-holding capacity, and the sod remains green when grass fails on other soils.

Paxton loam, though of small total area, is one of the important agricultural soils. At least 85 or 90 per cent of it is cleared and farmed. The small area of forest still standing is largely in wood lots of hardwood trees, with oak predominating. The cleared land is

predominately in mowing. A small acreage, which generally includes the stonier sides of the drumlin, is devoted to permanent pasture. Corn (silage), oats, buckwheat, clover, sweet corn, and potatoes are the crops grown on the small area in intertilled crops. They are usually grown in small patches.

The yields of general farm crops and vegetables are usually good. Hay yields from 1 to 3 tons to the acre, depending on the season, fertilization, and the condition of the fields before seeding. Corn for silage yields from 10 to 15 tons to the acre. Corn and oats make good yields of grain. Potatoes do only fairly well.

Most of this land is kept in mowing, consisting of timothy alone and timothy and clover. Oats are often used as a nurse crop for grass. Two or three cuttings of hay are made a season. Mowings are used until the timothy begins to fail, and the land then is used for pasture until such time as it is convenient to reseed. Consequently there is a comparatively small acreage in permanent pasture. Sod land is usually plowed in the fall and harrowed in the spring. The average depth of plowing is 7 or 8 inches. Manure is largely depended on to keep up fertility, little commercial fertilizer and very little lime being used. Some pastures contain considerable sweet fern, hardhack, or high-bush blueberry, but most of the pastures are kept clean of brush. Most of the stones on this land have been removed.

The current selling price of Paxton loam ranges from \$40 to \$150 an acre, depending on the location and improvements. The price of average farm land is from \$75 to \$100 an acre.

This soil, though of small total area, comprises some of the best open farm land in the districts where it occurs. It can be readily utilized for general farming, orcharding, and dairying. It is usually sour, needing about 1 ton of burnt lime to the acre every four or five years, especially where clover or other legumes are grown. With the use of lime and manure, no other form of fertilizer need be used. The tops of the drumlins make excellent sites for market gardens, and the sides of the hills are natural orchard locations.

Paxton loam, stony phase.—The stony phase of Paxton loam occurs mostly as boulder patches on the sides of the drumlins, but in a few isolated places the stony areas cover the entire hill or drumlin. Aside from the stone content, this soil is very similar to typical Paxton loam. The stones, consisting mostly of medium-sized or large boulders of granite and schist, with some slabs of schist and slate, are found in profusion on the surface and throughout the entire soil. Mingled with these stones is a quantity of small fragments of schist and slate.

This stony soil is not extensive and therefore is not important. About 50 or 60 per cent of it is cleared and is almost exclusively in permanent pasture. Fifty per cent or more of the pastures are covered with brush, consisting of sweet fern, hardhack, blueberries, sumac, and other shrubs. Where kept clear of brush, pastures are excellent. In most fields no attempt has been made to remove any but the smaller stones.

This soil has a low agricultural value as compared with the typical soil. It currently brings between \$20 and \$40 an acre.

This soil can best be utilized for pasture but should be kept free from brush to give the best results. Applications of some form of phosphatic fertilizer should be made to improve the sod. Part of this land could be advantageously used for orcharding.

PAXTON GRAVELLY LOAM

In cleared areas the topsoil of Paxton gravelly loam is dark-brown or brown, mellow gravelly loam 6 or 8 inches thick. The subsoil is yellow or greenish-yellow, friable gravelly loam which becomes paler with depth and grades, at a depth of about 24 inches, into gray or greenish-gray, compact partly weathered heavy till. The substratum contains considerable gravel, which is tightly compact and cemented with fine earth particles. The gravel present in this soil consists mainly of small schist and slaty fragments with some quartz. There is also a very small quantity of stone, consisting of small slabs and subangular pieces of schist with a smaller quantity of partly rounded granite boulders.

Paxton gravelly loam occurs entirely on the high, smoothly rounded hills that extend from the southern part of Pepperell Town through Groton Town and into the northern part of Ayer Town. Areas are strictly of the drumlin or drumleir type, having dome-shaped tops, smoothly sloping ends, and fairly steep sides. The hills are oval in shape, with their elongated axis north and south. Drainage is well established, although the soil has a fairly large moisture-holding capacity and retains moisture even during dry seasons.

Paxton gravelly loam is not extensive but agriculturally is one of the most important soils in the northwestern part of the county. Practically all of it is cleared and used for pasture, mowing, and orchards. The small forested areas are utilized as wood lots. In them oak, chestnut, and birch are the principal trees, and there is little underbrush. Pastures are fairly free from brush and furnish good grazing. Intertilled crops are grown only in small patches. Orchards are extensive, and some of the best apple and peach orchards in the county are found here. Potatoes and tomatoes are grown for market, and both give good yields. Hay yields from 1 to 2½ tons to the acre.

Timothy and clover are sown for mowing and rye and buckwheat are used as catch crops or as cover crops in orchards. Most of the orchards are cultivated in the spring, and rye or buckwheat is planted in the summer. The gravel acts as a mulch on the surface, relieving to some extent the necessity of frequent cultivation.

The price of this land varies to some extent, depending on improvements and location. As most of it is cleared and well located it is held at comparatively high prices, currently selling for as much as \$250 an acre.

This land is fairly well farmed, but much larger yields could be obtained if lime and more manure were used. As much of this land is in pasture and sod, little attention is given to increasing yields. It is adapted to orcharding and dairying.

CHARLTON LOAM

Where forested Charlton loam has a surface layer, from one-half to 1 inch thick, of dark-brown or almost black loam underlain by brown or rust-brown loam which continues to a depth of 5 or 6 inches. In cleared areas the soil is rich-brown or dark-brown medium mellow loam 7 or 8 inches thick. The subsoil is rust-brown or yellowish-brown, friable loam, slightly heavier than the topsoil. At a depth of 15 or 20 inches, the subsoil grades into pale yellowish-

brown or ochreous-yellow loam of about the same texture and structure as the upper part of the subsoil and invariably heavier than the corresponding layer in Gloucester loam. In places a few greenish mottles may be present. Below a depth varying from 24 to 30 inches, the subsoil shades into greenish-yellow or greenish-gray partly weathered, compact till of loamy texture, which continues to bedrock. A small quantity of gravel and small pieces of schist are present throughout the soil and in the substratum, but they are more noticeable below a depth of 15 or 20 inches. A few stones and small boulders are scattered on the surface and throughout the entire till deposit. Most of the loose stones have been piled into fences, leaving the fields fairly free from stones.

Charlton loam is derived from glacial-till deposits which are commonly from 10 to 40 feet thick over the bedrock. This soil occurs on low, smooth, rounded, oblong or drumloid hills, and in many places caps the tops of ridges and hills having more or less stony hillsides. Areas are smooth, varying from gently sloping to sloping and hilly. Drainage is thoroughly established, but the soil has an excellent moisture-holding capacity, and crops rarely suffer, even in dry seasons.

Charlton loam occurs in scattered areas in the western part of the county in the towns of Marlboro, Hudson, Littleton, Groton, Shirley, and Ashby. It is not extensive in total area but is an important agricultural soil. About 40 per cent of it is in second-growth timber consisting of chestnut, oak, maple, birch, and white pine, and about 5 per cent is occupied by towns and buildings. The cleared area is used for mowing, general farm crops, pasture, and orchards. The acreage in pasture is small, as is also that in intertilled crops. Corn, for silage and for grain, sweet corn, oats, rye, buckwheat, clover, and potatoes are grown. Vegetables are grown for home use and to some extent for market. A number of highly successful commercial apple orchards are located on this soil in Littleton and Hudson Towns.

The crop yields on this soil are good. Hay yields from 1 to 2½ tons to the acre; silage corn from 10 to 12 tons; and potatoes from 100 to 250 bushels. Corn and oats give good yields. Apples do exceptionally well. The trees make a healthy growth, and the fruit is of good quality.

Rye and buckwheat are used as summer cover crops in orchards; timothy and clover are grown for hay; oats are sometimes used as a nurse crop for grass; and corn is grown almost entirely for silage. The available manure is spread in the winter, but very little commercial fertilizer or lime is used.

Charlton loam is desirable farming land. It currently sells at prices ranging from \$50 to \$250 an acre, depending on the location and improvements. Average farm land ranges in price from \$75 to \$150 an acre. Cut-over areas or areas covered with second-growth forest of little merchantable value sell at a fairly reasonable price, but where the location is good or the land is in orchards the price is very high.

Charlton loam is good grassland and can be utilized advantageously for dairying. It is also good, productive land that can be used for general farming. It is fairly free from stones and for this reason is adapted to the growing of market-garden crops. It is best adapted to what are termed the heavy crops, such as cabbage, turnips, beets,

and beans. There are a number of excellent apple-orchard sites on this soil.

Most of this land is sour, and burnt lime should be applied at the rate of 1 ton to the acre every few years. Where lime and manure are used, no commercial fertilizer is needed unless the land is to be heavily cropped to market-garden crops. In this case, it is advisable to use fertilizers suited to the crops to be grown.

CHARLTON STONY LOAM

Charlton stony loam has much the same horizons of color, texture, and structure as has Charlton loam, but it contains a quantity of stones consisting of fragments and blocky pieces of schist and boulders of granite. These are scattered on the surface and throughout the entire till deposit. Bedrock is usually present at a slighter depth than it is in the loam soil of this series.

This soil occurs on sides and slopes of hills on the tops of which is Charlton loam, but in many places the stony loam covers the entire hill. In general, such steep areas would be more completely drained, but in areas of this soil the hillsides are affected by seepage from the higher levels, and Charlton stony loam in most places is not so well drained as the other Charlton soils.

Most of this land is in timber similar to that on Charlton loam. The cleared areas are used, for the most part, for pasture land, but a few areas are in mowing, and patches of most of the crops produced on Charlton loam are grown. The yields compare favorably with those on Charlton loam, but this soil is less desirable for farming and is held at a correspondingly lower price bringing between \$20 and \$50 an acre.

Charlton stony loam would make fairly good farming land if the stones were removed, but the cost of removal would probably outweigh the benefits derived. It can best be utilized for pasture land, as it furnishes excellent grass where the brush is kept down.

CHARLTON FINE SANDY LOAM

In forested areas Charlton fine sandy loam has a surface covering, 1 or 2 inches thick, of dark forest mold underlain by brown fine sandy loam which continues for several inches before passing gradually into the subsoil. In cleared areas the soil, to a depth of 6 or 8 inches, is dark-brown or brown mellow fine sandy loam. The subsoil is yellowish-brown or ochreous-yellow, rather mealy fine sandy loam which changes in color, at a depth of 15 or 20 inches, to yellow or pale yellow. Below a depth of 24 or 26 inches, the subsoil grades into greenish-yellow, slightly compact, partly weathered till of fine sandy loam, sandy loam, or loam texture. This continues to bedrock. This soil, although underlain by fairly deep till, is inclined to be ledgy. Both topsoil and subsoil contain a small quantity of gravel and a few fragments of schist and granite boulders, but the stones are much less in evidence than on Gloucester fine sandy loam.

This soil is derived from glacial till composed largely of crystalline rock. It occurs in irregular rounded or oval areas in a rather restricted belt in the west-central and northwestern parts of the county. Most of the areas are in the town of Boxboro, in the southern part of Townsend, the central part of Groton, and in Marlboro Towns.

The soil occurs on fairly level areas and on low hills and ridges, with smooth, gently sloping sides. The surface is smooth and is almost free from stones. Drainage is well established.

Charlton fine sandy loam is one of the soils of small extent that is fairly important agriculturally. About 50 or 60 per cent of its area is cleared and used for farming. The forests consist of second-growth chestnut, birch, oak, maple, and white pine. Much of the cleared land is in mowing, a small area is in pasture, and the remainder is in cultivated crops and orchards. Corn for silage, oats, and clover are the important crops. Small patches of sweet corn, potatoes, and vegetables are grown. A number of commercial apple orchards are in Littleton and Westford Towns. Rye and buckwheat are grown in the orchards as summer cover crops.

Hay yields from 1 to $1\frac{1}{2}$ tons to the acre, corn silage from 8 to 10 tons, oats from 20 to 30 bushels, and potatoes from 100 to 250 bushels. Clover makes a good stand, especially where the land is limed. Apple trees thrive and though, unless fertilized, they do not bear quite so heavily as trees on Charlton loam, the fruit is of good quality.

Charlton fine sandy loam does not have the natural fertility or crop-producing power of the heavier soils, but it is more productive than Gloucester fine sandy loam. It is desirable for farming because of its comparative freedom from stones. This land is plowed fairly deep, except where it is inclined to be ledgy. Plowing is usually, but not always, done in the fall, as the soil is naturally mellow and comes into good tilth when plowed in the spring. Oats are used as a nurse crop for grass, and clover is sown with timothy for hay. This is mowed until clover fails and is then used for pasture. The available manure is broadcast during the winter. Little commercial fertilizer is used except on orchards, and lime is used to a very small extent.

Charlton fine sandy loam currently sells at prices ranging from \$40 to \$200 an acre, depending on the location and improvements. The average price for good open farm land is between \$75 and \$100 an acre and for woodland is between \$40 and \$50. If it is located on main roads near residential sections or if it is planted to orchards, the land commands a much higher price.

Much of this land is deficient in organic matter. This can be added by turning under sod or by using larger quantities of manure. Larger quantities of manure can be provided only by increasing the number of livestock kept. More clover should be grown than at present. Where clover sod is desired or where market-garden crops are to be grown, from 1,000 to 1,500 pounds of burnt lime to the acre should be applied before seeding to clover or every few years where vegetables are grown. This land is not particularly fertile, and commercial fertilizers should be used for nearly all crops, especially for market-garden crops. The soil is somewhat adapted to the growing of potatoes. It is also adapted to peaches, apples, and other tree fruits of this region, though apples are the only fruits produced to any extent.

CHARLTON STONY FINE SANDY LOAM

Charlton stony fine sandy loam is very similar to Charlton fine sandy loam, and the texture is the same with the exception of the larger quantity of stones contained in the stony soil. The stones

consist of slabs of schist, pieces of quartz, and boulders of granite. The till ranges from shallow, with the rock cropping out in places, to fairly deep. In places it is very ledgy, the ledges representing the outcrop or near outcrop of the harder quartz schist strata.

Charlton stony fine sandy loam occurs in scattered areas, mostly in the towns of Marlboro, Littleton, Shirley, and Townsend in close association with Charlton fine sandy loam. It occurs, in many places, on the steeper hillsides where the ridge top is covered by Charlton fine sandy loam. In other places, the stony soil covers the entire hill. Areas are smoothly sloping or steep, and drainage is thoroughly established.

Charlton stony fine sandy loam is not extensive and is not very important agriculturally. Between 60 and 70 per cent of it is forested with second-growth chestnut, birch, oak, and scattered hardwoods and white pine. The cleared area is in pasture, mowing, orchards, and a small acreage in cultivated crops. The cultivated crops consist entirely of small patches of corn (silage and sweet), oats, rye, clover, potatoes, and garden vegetables. The yields of crops are not high, as little attention is given to farming this soil. There are a number of commercial apple orchards and some small home orchards containing mixed fruits. Dairying is a minor industry.

Many of the loose stones have been removed from cultivated fields, but enough are left in most places to interfere with cultivation. Though the ledgy nature of the land militates against its use for intertilled crops, it is better suited to mowing than most of the stony soils and is fairly well suited to orcharding. The selling price is slightly lower than that of Charlton fine sandy loam.

CHARLTON SANDY LOAM

Where forested, Charlton sandy loam has a surface layer, about an inch thick, of dark forest mold underlain by a very thin gray layer which grades into brown sandy loam. This, in turn, at a depth of 3 or 4 inches below the surface, grades into the subsoil. In cleared fields the soil, to a depth of 6 or 8 inches, is dark-brown mellow sandy loam. The subsoil is yellowish-brown or ocherous-brown friable sandy loam which grades, at a depth of 20 inches, into pale-yellow sandy loam of the same structure as the upper part of the subsoil. At a depth ranging from 24 to 30 inches, the subsoil grades into greenish-gray fairly compact heavy sandy loam or loam till which continues to bed-rock. Scattered over the surface and throughout the entire deposit is a noticeable quantity of schist rocks and fragments and some granite boulders. This soil occurs as fairly deep or medium sheet till capping the hills or top of the old plateau region in the extreme northwestern part of the county in the town of Ashby. The average elevation above sea level is about 1,000 feet and the range of elevation is from 600 to 1,100 feet. Although this soil lies at a high elevation, areas are fairly smooth, the maximum local difference in elevation in few places being more than 150 feet. Drainage is well established. This soil has a good moisture-holding capacity, and crops rarely suffer even in dry spells.

Charlton sandy loam, though not extensive, is one of the important soils in the region in which it occurs. About 60 per cent of it is cleared and farmed. The remainder is covered with second-growth chestnut, oak, birch, hard maple, and white pine. The cleared area

is devoted largely to mowing, but small patches of corn, oats, buckwheat, rye, potatoes, and vegetables are grown. Most farmers have a small orchard and the complement of animals and equipment found on the average New England farm.

Crop yields are better than the average, comparing favorably with those on the loam soils of the county. Hay yields from 1 to 2 tons to the acre; potatoes from 100 to 250 bushels; and oats from 25 to 30 bushels.

This land is managed in much the same manner as Charlton loam. It is desirable farming land but is located farther from markets than most of the other good soils and for this reason does not command so high a price as other soils of the same productive power. Its selling price ranges from \$40 to \$100 an acre where the soil is improved but is lower for forested areas, depending on the quantity and quality of the merchantable timber.

Charlton sandy loam can be improved by following the methods described for Charlton loam. It is well suited to general farming in connection with dairying or stock raising.

CHARLTON STONY SANDY LOAM

Charlton stony sandy loam differs from Charlton sandy loam mainly in its larger stone content. The stones consist of slabs, fragments, and, in places, large pieces of schist, and granite boulders are strewn on the surface and embedded in the soil. This soil is derived from glacial till consisting of schist and granite material ranging in thickness from shallow to comparatively deep.

Charlton stony sandy loam is associated with Charlton sandy loam, usually occurring on the steeper hillsides or in some places on an entire hill. Most of this land is in the towns of Ashby and Pepperell.

This soil is of small total area and of little agricultural importance. About 70 per cent of it is forested, mostly by second-growth oak, chestnut, hard maple, beech, white pine, and some spruce. The cleared area is in pasture, with only small patches in mowing or cultivated crops. Much of the pasture contains brush, but where there is not too much brush it furnishes good grazing.

Charlton stony sandy loam should either be used for pasture land or left in forest.

COLOMA LOAM

The topsoil of Coloma loam is brown or dark-brown, heavy fine sandy loam or light mellow loam from 6 to 10 inches thick. The subsoil is yellowish-brown or light brownish-yellow loam, but it becomes paler in color with depth and grades at a depth ranging from 24 to 30 inches, into pale-yellow or gray, partly weathered slightly compact drift of a sandy-loam texture. This soil is the weathered surface of deep glacial drift derived from sandstone, slate, and quartzose conglomerate. Some gravel from the disintegrated conglomerates is found in places and a few rounded and angular granitic boulders and slabs of slate are scattered over the land. Most of the loose stones, however, have been piled into fences, which surround the fields, or have been used in building, leaving the fields fairly free from stone.

Most of the Coloma loam occurs in drumlin or drumloid forms, the hills having smooth, rounded surfaces on top and fairly steep sides.

The hillsides in most places are occupied by Coloma loam, stony phase. Some areas occur on low, rounded ridges and hills and stretches of nearly level or gently rolling land. Drainage is usually good.

Coloma loam is not extensive. The largest areas occur in the town of Newton, where this soil occupies most of the upland. Smaller detached areas are in Lowell and Dracut Towns.

Practically all of this land has been cleared and used for farming at one time, but much of it is covered with buildings at present, and indications are that nearly all of it will be used for that purpose within the next decade. Judging from the few remaining trees and the forest growth on this soil in the county to the south, the original forest consisted mainly of oak, hickory, beech, and white pine, followed by a second growth of oak, chestnut, birch, and pine. The cultivated lands are used for general farm crops in connection with dairying, and for market-garden crops. Hay (timothy and clover), silage corn, and oats are the leading farm crops, and nearly all the vegetables common to this county are grown for market. Potatoes, cabbage, beans, beets, turnips, carrots, and tomatoes probably are grown on a larger acreage than other market-garden crops.

Crop yields are better than the average for the county. The dairy farmers make a practice of returning the manure to the land, and the market-garden farmers use large quantities of fertilizer, keeping the soil in a high state of productivity.

The current selling price of this land, as farm land, ranges from \$150 to \$300 an acre. Places close to town developments are held at prices as high as \$1,000 an acre. Some of these areas are used for truck crops pending the time when they will be needed for buildings.

Coloma loam, gravelly phase.—The gravelly phase of Coloma loam differs from the typical soil in that rounded gravel occurs on the surface, throughout the soil, and in the substratum. This gravel consists chiefly of rounded quartz, with some waterworn granitic, sandstone, and slate gravel, and constitutes from 20 to 30 per cent of the soil mass. The gravel occurs mainly where the soil is derived from conglomerates and represents the disintegrated conglomerate.

This gravelly soil occurs in close association with the typical soil, occupying, as a rule, lower hills but in some places occurring in drumlin form. Most of the area that is not covered by buildings is used for market-garden crops. The gravel in no way interferes with cultivation, and it forms a mulch that helps to conserve the moisture.

Coloma loam, stony phase.—In forested areas the stony phase of Coloma loam has a shallow covering of leaf mold over a layer, from one-half to 1 inch thick, of dark soil mixed with organic matter. This grades into light-brown, mellow, heavy fine sandy loam or light loam which continues to a depth of 4 or 5 inches, then grades into the subsoil of yellowish-brown mellow loam. In cleared areas, the surface soil is dark brown to a depth of 2 or 3 inches, where it becomes light brown. It passes rather abruptly into the typical subsoil at a depth of 6 or 8 inches below the surface. The subsoil becomes paler in color and lighter in texture with depth and grades, at a depth ranging from 24 to 30 inches, into gray, sandy, unweathered drift. The surface soil contains a quantity of angular and subangular sand-

stone, conglomerate, and slate and smaller quantities of rounded or partly rounded granite boulders.

This phase of soil occurs more or less on steep hillsides, in association with the typical soil, although in some places it covers the entire drumlin. Most of it is in Dracut and Lowell Towns, but a few small scattered areas are in Newton Town. Nearly all of this soil is in forest. Some of it is included in the city park system of Lowell. Most of it is too steep for cultivated crops and should be left in forest.

COLOMA SANDY LOAM

In forested areas Coloma sandy loam has a covering, from 1 to 2 inches thick, of dark forest mold underlain by a 1-inch layer of dark-gray sandy loam which grades into yellow or yellowish-brown sandy loam. In old or permanent pastures, the surface soil, to a depth of 2 inches, is dark-brown sandy loam mixed with organic matter. This grades into a 2-inch or 3-inch layer of dark-brown sandy loam. In plowed fields the soil is from 6 to 10 inches thick and consists of grayish-brown or brown sandy loam. The subsoil is yellowish-brown mellow sandy loam which becomes lighter in color with depth and passes gradually, at a depth of 20 or 24 inches, into gray or yellowish-gray sandy unweathered drift, fairly loose and open. Some stones, consisting mainly of subangular pieces of sandstone, conglomerate, slate, and a few rounded boulders of granite rock, are scattered through the soil, but these do not occur in sufficient quantities to interfere with cultivation. Some gravel, mostly quartz, is mixed with the soil.

The parent material is fairly deep glacial drift derived chiefly from sandstone and conglomerate, with a small admixture of slate, granite, and other crystalline rocks. Areas of the soil are fairly smooth or rolling and hilly. The drainage is partly internal and is inclined to be excessive. This soil is not extensive, being found for the most part in the central and eastern parts of Dracut, the northern part of Lowell, and in Tewksbury Towns.

Owing to its small total area Coloma sandy loam is not agriculturally important, but most of it is cleared and used for pasture, farm crops, and market gardens. A number of dairies are located on it. Corn (silage), oats, hay (timothy), and rye are the principal crops. Sweet corn, potatoes, asparagus, and practically all the vegetables common to this county are grown. Manure and commercial fertilizer are used to increase yields as this soil is naturally low in productive power. Most of the commercial fertilizers are used on vegetables. Fairly heavy applications of truckers' or high-grade fertilizer are made. The soil is mellow and easily managed under a wide range of moisture conditions. It is not primarily a good grass soil, and special attention should be given to building up the land by turning under sod or cover crops before seeding to grass.

The location of this soil is such that it is held at prices in excess of its farming value. It is ideally located for raising market-garden crops.

Coloma sandy loam, gravelly phase.—Coloma sandy loam, gravelly phase, differs from the typical soil in having a larger proportion of stones and gravel on the surface and throughout the soil. It occurs in association with the typical soil, usually on the steeper hillsides or higher hills, in some places covering the entire hill. The drainage is inclined to be excessive.

Most of this soil is forested with second-growth oak, chestnut, birch, and maple, and some white pine. Most of the cleared area is used for pastures, which contain considerable sweet fern, gray birch, and scrub oak.

The value of this soil is much lower than that of the typical soil. It can be utilized for pasture land, but it furnishes only indifferent grazing. The rougher areas should be left in forest or should be reforested to white pine.

COLOMA FINE SANDY LOAM

In forested areas Coloma fine sandy loam has a covering, 2 or 3 inches thick, of dark forest mold underlain by a thin layer of gray fine sandy loam which rests on grayish-brown fine sandy loam 3 or 4 inches thick. In cleared places the soil is dark-brown fine sandy loam which grades into the subsoil at a depth of 6 or 8 inches. The subsoil is mellow, yellowish-brown fine sandy loam which becomes lighter in color and texture with depth. At a depth of 20 inches it is pale-yellow fine sand. At a depth ranging from 24 to 30 inches this grades into pale-gray or yellowish-gray sandy unweathered drift. Some gravel and stones, ranging in diameter from a few inches to several feet, are scattered over the surface and throughout the topsoil and subsoil. The gravel consists largely of sandstone and conglomerate, but some slate slabs and partly rounded granitic boulders are present.

Coloma fine sandy loam is not an extensive soil and occurs exclusively in small areas in Newton, Lowell, and Dracut Towns. Areas are smooth or sloping and hilly but in general are smoother than areas of Coloma loam. Drainage is well established. This soil in this county probably contains a larger admixture of granitic material than it does in the region farther south, in Bristol County. The glacial till from which it is derived is fairly deep, the depth to bedrock ranging from 5 to 30 feet. It is derived from sandstone, conglomerate, and other crystalline rocks.

Most of this land is used for buildings and the remainder will, in a short time, be built up with suburban extensions. For this reason it has very little agricultural future. Small areas are now used mainly for market-garden crops. The yields are fairly good, owing to the intensive method of managing these farms. Large quantities of manure and commercial fertilizer are used.

Coloma fine sandy loam, stony phase.—Coloma fine sandy loam, stony phase, differs from the typical soil in its greater stone content. The stony soil occurs in connection with the typical soil, occupying the higher hills and steeper slopes of the fine sandy loam areas. Drainage is inclined to be excessive. In places the till is shallow, exposing the bedrock, which varies from sandstone to conglomerate according to the region in which it is developed, sandstone being found in Dracut Town and conglomerate in Newton Town. Very little of this kind of soil is under cultivation, and it is of little importance agriculturally.

DUTCHESS SLATE LOAM

In forested areas the surface soil of Dutchess slate loam consists of a $\frac{1}{2}$ -inch or a 1-inch layer of leaf mold more or less mixed with dark-brown mineral soil material which rests on light-brown,

mellow fine sandy loam or light loam containing some gravel. In cleared fields the soil, to a depth of 6 or 8 inches, is dark-brown or rich-brown mellow gravelly or slaty loam which grades into a yellow or pale yellowish-brown friable but heavy gravelly loam subsoil. Below a depth of 20 or 24 inches, and in places nearer the surface, the subsoil is greenish-yellow gravelly loam, more compact but slightly lighter in texture than the upper part of the subsoil. Below a depth of 30 or 36 inches the substratum is greenish gray and compact. In places the deep substratum is streaked with rust brown, and in other places it contains a noticeable quantity of sand mixed with the slate gravel. The gravel consists almost entirely of slate chips or slate gravel, partly disintegrated to a depth of 2 feet. In the virgin state this soil was comparatively free from stone. A few granitic boulders and slabs of sandstone and slate are scattered on the surface, but most of these have been used for fences or buildings.

Dutchess slate loam is derived mainly from slate rock, with less quantities of granitic and other rock material, which has been piled as glacial till into drumlin and drumloid forms. The slate is somewhat softer than most of the rock material of this region, and the action of the glacier resulted in the material being comparatively finely ground, leaving few large rocks and a large mass of slate chips and finer material.

This soil occurs on rounded hills and smooth-sided ridges having a typical drumlin relief. It is conspicuous as the high ground in the cities of Cambridge, Somerville, and Everett, in the town of Watertown, and in the southern part of Belmont and Malden Towns. Drainage is good, except in the few spots on the hillsides affected by seepage.

The original forest growth has long ago been cut from this land. The remaining forest, consisting of small groves of oak and some scattered elm and white pine, gives evidence that the land was once covered with a heavy growth of hardwoods. Nearly all of this land is now occupied by cities, towns, and suburban extensions. The small area still devoted to farming will, in the course of a few years, be covered with buildings.

The acreage in farms is given almost entirely to market-garden crops or the land lies fallow. Nearly all crops produced in the Boston district, chiefly sweet corn, potatoes, tomatoes, and cabbage, are grown on this soil. Both manure and commercial fertilizer are used in large quantities on these crops, and the yields are unusually good.

The current selling price of this land is higher than the agricultural value would warrant, owing to its location. Most of the remaining land is held for building lots and subdivisions, and very little, if any, of it could be bought for less than \$1,000 an acre. Farming on land at this price must from necessity be intensive if a fair return is to be made on the investment. Some of the soil is farmed to the best advantage and other farms are neglected.

BROOKFIELD LOAM

Brookfield loam, to a depth of 6 or 8 inches, is dark-brown or dark-reddish rust-brown mellow loam. The subsoil is yellowish-brown or reddish-brown material of medium loam texture, fairly firm and inclined to be gritty. At a depth of 15 or 20 inches, it becomes

ocherous yellow in color and below a depth varying from 24 to 30 inches becomes yellow, pale yellow, or greenish yellow. The next lower layer consists of slightly lighter-textured and more mealy material which continues to bedrock. Many small fragments of bedrock are found in the subsoil, and fewer are present in the topsoil. These consist of angular pieces of rust-brown schist. A few stones are scattered on the surface and throughout the soil and substratum. These consist of slabs of schist and scattered, rounded granite boulders. This soil is derived from glacial drift which ranges from 3 to 20 feet in thickness but averages 5 or 6 feet. The drift is derived mainly from Brimfield schist, which crops out in narrow strips in the west-central part of the county. It is rust-colored biotite schist which received its characteristic ocher color from the quantity of iron pyrites it contains. In places the bedrock is within 3 feet of the surface. In these places the rock is usually partly weathered, giving a redder color than typical to the subsoil.

Brookfield loam occurs in scattered, isolated areas in the towns of Chelmsford, Westford, and Hudson. It commonly occurs on hilltops, in oval or elongated areas. Areas range from smoothly sloping to hilly. Drainage is internal for the most part but is well established. Most of the loose stones have been piled into fences, leaving the fields fairly free from rock.

This soil has a very small total area but is fairly important. Practically all of it is cleared and farmed or planted to orchards. Mowing occupies a larger acreage than all other crops, and only a small acreage is in pasture. Corn (silage), oats, rye, buckwheat, clover, and potatoes are the leading crops; sweet corn and other vegetables are grown in small patches; and a few commercial apple orchards are found in Westford and Chelmsford Towns.

The soil is fairly productive. Hay yields from 1 to 2½ tons to the acre. Corn and oats give fairly good yields, and clover does well. Potatoes yield from 100 to 250 bushels to the acre. The soil furnishes good pasturage. This land is managed in much the same way as Charlton loam and the other upland loam soils of the county. The current selling price ranges from \$50 to \$250 an acre, depending on the location and improvements.

Brookfield loam is a good soil, suited to general farm crops, dairying, and orcharding. Potatoes thrive and could be more extensively grown. Clover seems to make good stands and should be grown on a larger acreage.

BROOKFIELD STONY LOAM

Where forested, Brookfield stony loam has a one-half or 1-inch layer of dark leaf mold on the surface. This rests on a 2-inch layer of dark-brown loam, underlain by brown or reddish-brown mellow loam which continues for several inches before it grades to the subsoil. In cleared areas, the soil is rust-brown or reddish-brown mellow loam 6 or 8 inches thick. The subsoil is friable reddish-brown or ocherous-brown material of medium loam texture, having considerable body which, at the depth of 20 inches, grades to yellow or pale ocherous-yellow material but retains the same texture and structure as the upper part of the subsoil. At a depth ranging from 30 to 36 inches, the subsoil merges gradually with the substratum, which consists of greenish-yellow, fairly compact, medium-textured, partly weathered glacial drift containing a noticeable quantity of mica flakes. Many

small and large pieces of schist are scattered on the surface and throughout the entire deposit that gives rise to the soil, and a few boulders of granitic rock are present. The soil is derived from fairly shallow drift, and the partly weathered bedrock in places comes close to the surface. In these spots the topsoil and subsoil are redder in color than elsewhere. The till is derived from soft schist that readily disintegrated where it was exposed to weathering. In places it contains iron pyrites and in other places considerable mica.

This soil is found in fairly large areas in the towns of Carlisle, Chelmsford, Westford, Littleton, Hudson, Stow, and Marlboro, but the total area is not large when compared with the Gloucester stony soils. Brookfield stony loam occurs on hillsides and the sides of ridges of which Brookfield loam occupies the tops. In other places it covers the entire ridge or hill. Areas are gently sloping or steeply sloping and hilly, and drainage is well established.

Brookfield stony loam is fairly important, although little of it is cultivated at the present time. Fully 70 per cent of it is covered with second-growth forest, in which oak and chestnut predominate. The cleared areas are in pasture, except those used for orchards in Chelmsford and Westford Towns. The soil furnishes good grazing where there is not too much brush, but many of the pastures are filled with sweet fern, gray birch, and other shrubs. Several excellent commercial orchards, that seem to be in a thriving condition, are located on this land.

The current selling price of this land is not high unless it is planted in orchards, then it compares well with that of the other developed soils of the county.

BROOKFIELD STONY SANDY LOAM

Brookfield stony sandy loam differs from Brookfield stony loam in having a lighter texture, ranging from sandy loam to loamy sand, throughout the entire soil. It has a more pronounced ochreous-yellow color rather than a reddish cast. It contains more granitic material and less schist fragments than Brookfield stony loam, and the drift is deeper.

This soil occurs in close association with Brookfield stony loam and has essentially the same surface features. Drainage is almost entirely internal and is so well established that it is inclined to be excessive.

This soil is nearly all covered with second-growth trees, mostly oak, chestnut, and birch. A small area in pasture furnishes only fair grazing. A few orchards that seem to be in fairly good condition are located on this soil in Westford Town, and some small patches of vegetables were noticed. Aside from these developments the soil is not used for farming and is accordingly held at a low valuation.

Brookfield stony sandy loam can be used for peach orchards and for market-garden crops, but in either case it will be necessary to use commercial fertilizers to maintain yields.

BERNARDSTON SILT LOAM

In forested areas Bernardston silt loam has a surface layer, about 2 inches thick, of dark leaf mold, resting on a gray layer one-half inch thick which is underlain by dark yellowish-brown loam or silt loam 5 or 6 inches thick. In cleared fields the surface soil is dark-yellowish or grayish-brown loam or silt loam, 7 or 8 inches thick. The subsoil is yellow loam or silt loam, fairly firm but friable, which grades, at a

depth of 20 inches, into greenish-yellow, compact partly weathered drift. Below a depth ranging from 20 to 36 inches, the substratum is greenish-gray compact till containing some brown and a quantity of bluish-colored slate chips. The substratum below a depth of 3 feet is less compact than above.

This soil contains a few slabby pieces of slate, phyllite, and schist scattered on the surface and throughout the soil. These rocks represent the remains of the material from which the soil is derived. The drift is fairly shallow, bedrock coming close to the surface in places.

Bernardston silt loam occurs in the northwestern part of the county, mainly in Shirley, in the southeastern part of Townsend, the southwest corner of Pepperell, and the western part of Groton Towns. It occurs in rounded or irregular areas following the outlines of the flattened tops of the ridges or hills which it occupies. Areas are uniformly smooth or smoothly sloping. Drainage is internal, and though well drained the soil is not thoroughly aerated.

Although this soil is not extensive, it may be considered one of the important agricultural soils. About 50 per cent of it is forested with oak, gray birch, maple, and mixed hardwoods. The cleared area is used for mowing, pasture, and cultivated crops. Corn, oats, rye, millet, and vegetables are grown. A number of apple orchards are located on this land in Shirley Town. A few small dairies are operated, and nearly every farmer keeps a few milk cows. Most farmers have gardens, in which the vegetables common to this region are grown.

Hay yields from 1 to $2\frac{1}{2}$ tons to the acre; corn (silage) from 10 to 15 tons; oats and rye give fairly good yields; vegetables do exceptionally well; and apples give heavy yields but do not color so highly as on some of the hillier land.

This land is usually plowed to a depth of 7 or 8 inches in the fall and is harrowed in the spring. It is cold and wet in the spring and, owing to its heavy texture, difficulty is experienced in preparing a good seed bed. Corn is grown for silage and also for grain; oats are used mainly as a nurse crop for timothy and alsike clover which are used for mowing; and millet is grown if the hay crop is hurt by drought. This land furnishes good pasturage where the brush is kept down.

Bernardston silt loam currently sells at prices ranging from \$25 to \$150 an acre, depending on the location, improvements, or forest condition.

This land is naturally strong. It furnishes good grazing and mowing and can profitably be used for dairying or stock raising. It can be utilized successfully for such market-garden crops as cabbage, onions, beets, tomatoes, carrots, turnips, and sweet corn. It is not so highly recommended for apples as some of the more rolling land. The yields of apples are heavy, but the coloring is not in all cases up to the market requirements. This land is usually acid.

Bernardston silt loam, stony phase.—Bernardston silt loam, stony phase, is very similar to the typical soil, but it contains a quantity of loose slabs of slate, phyllite, schist, and granite scattered on the surface and throughout the entire soil mass. In places bedrock, which is almost everywhere phyllite, comes to the surface. The stone occurs in quantities sufficient to interfere with cultivation.

This stony soil is everywhere associated with Bernardston silt loam, occurring on the hillsides and steeper slopes and in places covering the entire ridge. The soil, except for patches in places where seepage comes to the surface, is well drained.

This stony soil is more extensive than the typical soil. It is nearly all in forest of the same character as is found on the typical soil, but in many places the timber is more valuable. The small cleared areas are used for pasture, but many of these are so filled with brush that they are known as brush pastures.

Bernardston silt loam, stony phase, currently sells for prices ranging from \$15 to \$25 an acre, but where the timber is merchantable the price is higher. Cleared pasture land, less than 50 per cent brush covered, if well located sells slightly above the average price.

This soil can best be utilized for pasture. Where the loose stones have been removed it has about the same crop-producing power as the typical soil except in the areas where bedrock comes close to the surface.

HOLLIS LOAM

The dark-brown loam surface layer of Hollis loam is a few inches thick and grades into dull yellowish-brown loam which continues to a depth of 4 or 5 inches before it merges gradually with the subsoil. The subsoil is yellowish-brown, mellow, medium loam which changes, at a depth of 12 or 14 inches, to greenish-yellow loam underlain, at a depth ranging from 20 to 36 inches, by rust-brown and greenish-yellow, partly disintegrated schist or slate. The entire soil mass contains fragments of schist and small pieces of platy shale or slate in noticeable quantities. A few scattered slabs of schist or slate and rounded boulders of granite are scattered on the surface and embedded in the soil, but on the whole this land is fairly free from stones. The soil is derived from shallow glacial till composed of schist and slate material. The bedrock formations, for the most part, are tilted so that the weathered ends protrude into the subsoil. In places, the glacial drift is fairly deep.

Hollis loam occurs on smooth hilltops and ridges over a comparatively small region in the northwestern part of the county. The largest areas are found in the town of Pepperell. Areas are smoothly or gently sloping and drainage, although nearly all internal, is well established.

Hollis loam is one of the inextensive but important soils of the county. More than half of it is cleared and farmed. Most of it is in mowing, but corn (silage), oats, rye, clover, and buckwheat are grown. Potatoes and vegetables are grown in small patches. Dairying and orcharding are the chief forms of agriculture. The forest growth consists of oak, chestnut, white pine, and scattered hardwoods.

Crop yields are fairly high, as this soil is well farmed. Hay (timothy) yields from 1 to 2½ tons, clover from 1 to 2 tons, corn from 40 to 75 bushels, and corn silage from 10 to 12 tons to the acre. Oats, rye, and buckwheat give fairly good yields, considering that little attention is given to these crops. Apples give good yields of excellent fruit.

This land is managed in the same manner as Charlton loam and other heavy soils of the county and probably can best be utilized for dairying. Its selling price ranges from \$50 to \$150 an acre, depending on the location and improvements.

HOLLIS STONY LOAM

Hollis stony loam is very similar to Hollis loam, but the stony soil carries a much higher proportion of gravel and stones than the loam. The till is, in general, shallower, bedrock cropping out or coming close to the surface in many places.

Hollis stony loam is associated with Hollis loam. Most of it occurs on the hillsides or sharper knolls, and its relief is more broken and hillier than that of the loam. Drainage is largely internal but is well established.

Hollis stony loam is slightly less extensive than Hollis loam. It occurs mainly in Pepperell Town, though a few small areas are in Groton Town. Most of this soil is covered with second-growth timber of oak, chestnut, birch, and mixed hardwoods. The few cleared areas are used mostly for pasture and furnish fair grazing if kept free from brush. This soil can best be utilized for pasture.

HOLLIS FINE SANDY LOAM

Hollis fine sandy loam, to a depth of 5 or 6 inches, is dark grayish-brown fine sandy loam. The subsoil is greenish-yellow heavy fine sandy loam or loam, fairly firm but friable, which grades downward into pale-yellow or greenish-yellow, slaty glacial drift that is only slightly compact. The entire soil mass contains a quantity of small platy slate and schist fragments, but very few stones are found at any place.

The surface relief is decidedly subdued, the soil occurring on low-lying, fairly level areas and hummocky stretches. In the latter places the bedrock of fissile slate comes close to the surface. In places, there is evidence that at least part of this material is water deposited. This soil is more extensive than the other Hollis soils, being found in fairly large areas in Pepperell and in Groton Towns.

Most of this land is cleared and used for agriculture. On the small wooded areas are pitch pine, birch, and scattered hardwoods. A fairly large acreage is in mowing, smaller areas are in pasture, and the remainder is in tilled crops. Corn for silage and grain, oats, rye, clover, potatoes, and vegetables are grown. General farming and some dairying, orcharding, and market gardening are practiced.

Crop yields are fairly good, comparing favorably with those on Hollis loam. More manure and fertilizer are used than on most of the upland soils.

Hollis fine sandy loam ranges in value from \$25 to \$150 an acre or more for some of the better-located areas. Where it has a hummocky surface and is covered with pitch pine it has a very low value.

This soil is fairly free from stones and can be cultivated easily. It could be used more extensively for market-garden crops, as nearly all the vegetables grown in this county seem to do well on it. It is suited to the growing of berries and small fruits. Clover should be more extensively grown. Most of this land is sour, and lime should be applied at the rate of 500 or 1,000 pounds to the acre, and possibly at a heavier rate where clover is sown.

WHITMAN LOAM

The topsoil of Whitman loam is very dark brown or almost black mellow loam, 10 or 15 inches thick, containing a large quantity of organic matter. The subsoil is gray or grayish-brown mellow loam

which continues to a depth of 20 or 24 inches, where it grades into grayish-yellow loam, mottled with rust brown, yellow, and drab. Below a depth varying from 26 to 30 inches, the subsoil is partly weathered grayish or gray till which becomes drab gray below a depth of 36 inches. The deep part of the subsoil and the substratum are lighter in texture than the upper part of the subsoil and the topsoil. Some stone fragments and boulders, mostly granite and gneiss, are scattered on the surface and throughout the entire soil and substratum.

Whitman loam is derived from glacial drift and occurs in low places, usually in association with the Gloucester soils. It occupies small areas scattered over the uplands. Most of this soil is in the southern part of the county. Areas are level, and drainage is poor.

This soil is not important, and only about 15 or 20 per cent of it is cleared. The remainder is forested with hardwoods, gray birch, soft maple, and white pine. Part of the cleared area is in mowing and pasture, and a still smaller acreage is in oats and corn. Hay cuts from 1 to 1½ tons to the acre. The yields of corn and oats are good, considering the little attention given to them. This soil furnishes good grass even in dry seasons. Many of the pastures contain a quantity of high-bush and low-bush blueberries and alder. Shallow open ditches usually serve to carry off the surplus water from the cultivated fields.

Whitman loam is held at a comparatively low price, as very little of it is improved. The selling price ranges from \$20 to \$50 an acre, depending on location and improvements, and some of the outlying areas sell at a much lower price.

Where cleared, this land can be used for pasture. Where properly drained it can be used for hay, corn, oats, and market-garden crops. It is sour, and burnt lime at the rate of about 1 ton to the acre should be used to get the best results from general farm crops or vegetables, but for grass and pasture, lime is not necessary.

WHITMAN STONY LOAM

Whitman stony loam differs from Whitman loam chiefly in its greater boulder content, both on the surface and through the soil. The proportion of stones ranges between wide limits, part of the ground being so covered with stones as to be considered very stony.

Like Whitman loam, this soil occurs on low areas throughout the upland. Areas are level or gently sloping, with poorly developed drainage. Whitman stony loam is known locally as stony meadow or stony swamp.

Whitman stony loam occurs in small areas in nearly all parts of the county. However, the total acreage is not large, and this can not be considered an important soil. Probably less than 5 per cent of it is cleared. Cleared land is used almost exclusively for pasture. The forest growth consists of hardwoods, birch, soft maple, some white pine, and, in the northern part of the county, some spruce. The pastures contain considerable brush and are not very good, except that they furnish grass even in dry seasons.

Whitman stony loam has a very low agricultural value, the selling price ranging from \$5 to \$20 an acre.

Most of this land should be left in forest, as the cost of clearing, ditching, and removing stones would exceed the benefits derived. It

can be used for pasture with little other expenditure than the cost of clearing.

HINCKLEY GRAVELLY SANDY LOAM

In wooded areas Hinckley gravelly sandy loam consists of a dark-brown sandy loam or fine sandy loam surface layer, a few inches thick, underlain by brown gravelly sandy loam which continues to a depth of 4 or 5 inches below the surface. In cleared areas, the soil is brown gravelly sandy loam to a depth of 6 or 8 inches. The subsoil of yellowish-brown gravelly sandy loam, fairly firm but friable, grades downward, at a depth ranging from 12 to 18 inches, into pale yellowish-brown or pale-yellow gravelly sandy loam, loose and open in structure. The subsoil, below a depth ranging from 24 to 30 inches, consists of gray gravel, coarse sand, and sand, with very little fine material. This material continues to the depth of the deposit and contains a few rounded granite boulders near the bottom of the formation. A few small included areas in Belmont and Watertown Towns have loam topsoils and loam-textured subsoil layers and contain a quantity of slaty gravel. Areas not covered with buildings are used for market-garden crops.

This soil is derived largely from coarse glacial drift occurring in kame forms and is composed mostly of granite, gneiss, and other crystalline rock material. The gravel consists of rounded, waterworn quartz, granite, gneiss, and in places some schist and slate. The few rounded stones found on the surface and throughout the soil and substratum are rounded granite and gneiss, ranging from a few inches to a foot in diameter. Drainage, which is almost entirely internal, is usually excessive to the extent that crops suffer in dry seasons.

Hinckley gravelly sandy loam occurs mostly in the valleys near the base of the hills or along the outer or stream edge of the terraces. It occurs in small areas over the entire county. It is rather extensive but is of little agricultural importance. Between 60 and 70 per cent of the soil is forested with white pine, gray birch, scrub oak, and chestnut, and some oak and pitch pine. The cleared area is largely in pasture, which contains many birch, scrub cedar, sweet fern, and blueberry bushes. Small areas are in mowing, corn, oats, rye, potatoes, and market-garden crops.

Crop yields are generally low. Hay cuts from one-half to three-fourths ton to the acre, depending on the season. Commercial fertilizer is used to a small extent, mostly on vegetables, and manure is used mainly for corn and garden crops. The hummocky surface of this land makes the use of improved machinery and the cutting of hay difficult. The stones and gravel do not materially interfere with cultivation.

The selling price of Hinckley gravelly sandy loam ranges from \$15 to \$100 an acre, depending on the location and improvements. The average price is about \$30 an acre for cleared areas and much less for fields grown up in sprouts.

This land can be utilized for pasture, but it is not well suited to grass. Owing to its droughtiness it is not adapted to general farm crops. It can be used for market-garden crops if large applications of manure and fertilizer are made. It is fairly well suited to the growing of small fruits, brier berries, and nursery stock. Rye and vetch probably do better than any other crops. The land makes excellent

locations for poultry ranches. Much of it could be used for growing white pine.

Hinckley gravelly sandy loam, dark-colored phase.—Where forested the dark-colored phase of Hinckley gravelly sandy loam is dark-brown loam or sandy loam to a depth of 2 or 3 inches, where it passes into reddish-brown gravelly sandy loam which continues to a depth of 5 or 6 inches before it grades into the subsoil. The subsoil is ochreous-yellow gravelly sandy loam, to a depth of 15 or 18 inches and is underlain by yellow gravelly sand, loose and open in structure, which continues to a depth of 3 or more feet. The substratum consists of alternate beds of sand and gravel, brown, yellow, and gray in color. In places the substratum consists of gravel and rounded stones, roughly assorted and stratified.

This land is decidedly hummocky. Drainage is largely internal and, like that of the typical soil, is excessive. This phase of soil occurs in rather scattered areas in the northwestern part of the county and along the broken edges of the terraces in the vicinity of Concord.

This soil supports the same tree growth as the typical soil and is used for the the same purposes and to about the same extent.

The selling price of this land in the western part of the county ranges from \$10 to \$30 an acre, but in the central part of the county areas are better located and command a much higher price.

HINCKLEY LOAMY SAND

In forested areas Hinckley loamy sand typically has a surface layer about 1 inch thick, of dark or almost black loam containing considerable leaf mold. This is underlain by brown loamy sand which continues to a depth of 4 or 5 inches before grading into the subsoil. The subsoil is yellowish-brown loamy sand, fairly loose and open in structure, which grades down into pale yellow and passes, at a depth ranging from 24 to 30 inches, into gray sand or coarse sand. The substratum is composed of bedded sand and gravel, which is somewhat stratified but in which the material is well assorted. The substratum is everywhere loose and incoherent.

Hinckley loamy sand is derived from glacial-outwash material, largely from granitic rocks, which has been piled into kames along the valley floor. Areas, although decidedly hummocky, are more smoothly rounded on hilltops than are areas of the other Hinckley soils. The deposits range from a few feet to 100 feet in thickness. This soil occurs in small, scattered areas in nearly all parts of the county. Drainage is mostly internal and, owing to the looseness of the subsoil, is excessive.

A number of small areas of this soil in the northwestern part of the county have a sandy loam surface soil and are much browner than typical, having decidedly yellower subsoils and substrata. A few small areas in the central part of the county, mainly in Framingham Town, have a loamy fine sand texture, and others have a decidedly coarse texture. Hinckley loamy sand is not important, as only about 10 per cent of it is cleared and used for farming. The remainder is forested with gray and brown birch, scrub oak, pitch pine, some chestnut, poplar, and white pine. The cleared areas contain many abandoned fields which are covered with broom sedge or birch sprouts. A small acreage is in pasture, a still smaller area is

in mowing, and some small cultivated patches and gardens are found.

Crop yields are low, even in good seasons, and a dry season may result in a complete failure.

This soil is not desirable for farming and, unless, it is well located in reference to city developments, sells for a low price. The current price of farm land is from \$15 to \$25 an acre.

This soil is droughty, is commonly deficient in organic matter, and has a low crop-producing power. Organic matter should be supplied and fertilizer used where any attempt is made at farming. Vetch and rye are good cover crops for this land. This soil, when properly managed, could be used for light market-garden crops, small fruits, and brier berries. The more broken areas should be left in natural forest or reset to white pine.

HINCKLEY STONY LOAM

In forested areas Hinckley stony loam is dark-brown or dark yellowish-brown loam, 3 or 4 inches thick, underlain by light-brown or yellowish-brown mellow fine sandy loam, sandy loam, or loam which continues to a depth of about 6 inches. Where cleared, the soil is dark-brown or dark yellowish-brown mellow loam 6 or 7 inches thick. The subsoil is yellowish-brown, fairly firm but friable gravelly sandy loam or gravelly fine sandy loam which, at a depth of 15 or 20 inches, grades into a bed of gray sand, gravel, and rounded boulders, somewhat stratified and roughly assorted. This material continues to the bottom of the formation, ranging from 10 to 100 feet in depth. A few boulders of granite or other crystalline rocks are on the surface and embedded in the soil. The parent material is glacial drift derived largely from granite and gneiss but in many places having admixtures of schist.

Small areas in the northwestern part of the county were derived mostly, or in part, from schist rock. These areas have much browner surface soils and more intense yellow subsoils and substrata than are common in the remainder of the soil.

Areas of Hinckley stony loam are rough and broken or hummocky, with some narrow, hogback mounds that stand from 30 to 60 feet above the valley levels but do not rise so high as the hills in the background. Drainage is excessive.

Nearly all of this land is forested with white pine, birch, oak, chestnut, and poplar. The small cleared areas are in pasture that furnish only fair grazing. The soil is best left in natural forest or set in white pine.

Hinckley stony loam is not valued very highly for farming. Its current selling price ranges from \$10 to \$30 an acre, depending on the quality and quantity of the timber and the improvements.

MERRIMAC SANDY LOAM

In forested areas Merrimac sandy loam has a surface layer, about 2 inches thick, of dark-brown sandy loam filled with roots and leaf mold. This is underlain by a layer of brown sandy loam several inches thick, which contains some fine materials. In cleared fields, the soil is dark-brown or brown mellow sandy loam 8 or 10 inches thick. The subsoil is yellowish-brown sandy loam, fairly firm and friable, which

grades, at a depth of 18 or 20 inches, into light yellowish-brown sandy loam, less firm and containing a noticeable quantity of rounded quartz gravel. The substratum, below a depth ranging from 24 to 30 inches, is mixed gray and yellow gravelly sand, loose and incoherent in structure, which is underlain by beds of gray sand and gravel from 20 to 50 feet thick. The rock from which this material is derived is largely granite and gneiss.

Merrimac sandy loam occurs on fairly level terraces in the central part, and in a few small, scattered areas in nearly all parts of the county. The largest areas are in Natick, Wayland, Concord, and Bedford Towns. In a few small areas in the western part of the county, the soil is influenced by schist material and is much browner than typical, the subsoil is more of an ochre color, and the substratum is yellower than is characteristic of this soil.

In several areas scattered over the northern part of the county the topsoil and subsoil are coarse sandy loam, and the substratum ranges from very coarse sandy loam, containing some gravel, to sandy gravel in which the gravel is very coarse and shows little assortment or stratification.

Areas of Merrimac sandy loam are prevailingly level. In places there are slight swells, but abrupt breaks are found only along the stream edge of the formation. Drainage is thoroughly established, owing to the porosity of the substratum. In dry seasons this land is inclined to be droughty.

From 35 to 40 per cent of the Merrimac sandy loam is in forest of white pine, birch, oak, and chestnut. The cleared area, aside from the land occupied by towns, is in mowing, pasture, and cultivated crops. A number of fields are lying fallow and are covered with broom sedge. Redtop, timothy, and clover are used for mowing. Corn (silage and grain), oats, rye, millet, and buckwheat are the field crops, and potatoes and sweet corn are grown on a fair acreage. Vegetables are grown for home use on most farms and are produced rather extensively for market in the Concord district. Asparagus, cabbage, kale, beets, celery, cucumbers, squash, and carrots are the leading crops. Strawberries are produced to some extent. Gladioli and dahlias are grown for market. Chickens are kept on most farms, and some farmers make a specialty of poultry. A few small dairies are in operation, but this soil is used only to a small extent for grazing livestock.

Under the ordinary farm conditions, crop yields are not very high. Hay averages 1 ton to the acre in the normal seasons but falls below this yield in dry seasons. Corn yields from 30 to 45 bushels; corn silage about 8 tons; oats from 30 to 45 bushels; and potatoes from 100 to 150 bushels to the acre. Grass does not thrive, and in dry seasons it has a tendency to burn out. Market-garden crops usually give good yields, as they are heavily fertilized.

This soil is easily plowed and forms a mellow seed bed with little cultivation. It can be plowed at almost any time, owing to the rapidity with which it dries out after rains. Little commercial fertilizer is used, except by market gardeners. Manure is used by dairy farmers and market gardeners. Liming is not usually practiced.

The current value of Merrimac sandy loam ranges from \$20 to \$250 an acre and is even higher for the land in the more favorable locations. The average price of farm land is between \$50 and \$150 an

acre. The lower prices prevail in the out-of-the-way locations where the soil is forested with trees of little commercial value.

This soil is deficient in organic matter, and this material should be added in fairly large quantities where the best results are desired. It is naturally of low productive power and must have manure or commercial fertilizer to grow crops successfully. It can be advantageously used for such market-garden crops as asparagus, beets, carrots, spinach, parsnips, turnips, tomatoes, strawberries, squash, and brier berries. This soil is used in Connecticut for the growing of tobacco, but heavy applications of commercial fertilizer, from 1 to $1\frac{1}{2}$ tons to the acre, are used for this crop.

MERRIMAC FINE SANDY LOAM

In wooded areas Merrimac fine sandy loam is dark-brown, mellow fine sandy loam which grades, at a depth of 2 or 3 inches, into brown mellow fine sandy loam which continues to a depth of 5 or 6 inches. In cleared fields the soil is dark-brown mellow fine sandy loam to a depth of 8 or 10 inches. The subsoil is yellowish-brown mellow fine sandy loam which becomes pale yellow and mealy and contains some gravel below a depth of 18 or 20 inches. Below a depth ranging from 24 to 30 inches, the subsoil changes to grayish-yellow or gray sandy loam containing a quantity of rounded quartz gravel. The substratum consists of beds of sand and gravel, more or less stratified and assorted but fairly loose and incoherent, lithologically composed of granite and gneiss with some schist and slate material.

Merrimac fine sandy loam occurs on the level stream terraces of the southern part of the county and on the terraces of Merrimack River in the northern part. It lies from 20 to 50 feet above stream level. The largest areas are in the towns of Framingham, Natick, Weston, Wayland, Marlboro, Ashland, Holliston, and Sherborn. Areas are level or gently undulating. Drainage is thorough, and if it were not for the level surface, crops would suffer for want of moisture in dry seasons.

Merrimac fine sandy loam, although not very extensive in area, is one of the agriculturally important soils. About 90 per cent of it is cleared, and of this area 15 or 20 per cent is covered with town developments. The tree growth includes second-growth white pine, gray birch, oak, and chestnut. The area that is farmed is devoted to mowing (timothy and clover), pasture, corn (silage, grain, and sweet), and small fields of oats, millet, rye, buckwheat, and potatoes. A large number of home gardens and a number of market gardens are located on this land. Some strawberries, raspberries, and currants are grown. A variety of fruit is grown in a number of home orchards. A few small dairies are in operation. Dairy farmers grow some hay and silage but depend on other soils for pasturage. Nearly every farmer raises chickens, and many make a specialty of poultry. Few other animals are kept on the farms on this soil.

Crop yields on this land are only moderate, unless areas are heavily manured or fertilized. Hay yields from 1 to $1\frac{1}{2}$ tons to the acre; corn (silage) from 8 to 10 tons and grain from 40 to 60 bushels; oats from 45 to 65 bushels; and potatoes from 125 to 250 bushels.

Merrimac fine sandy loam, owing to its mellowness and freedom from stones and gravel, is one of the easiest soils in the county to cultivate. Cultivations can be made at almost any time, as this soil

dries out readily after rains and comes into condition to work early in the spring. It is usually plowed 8 or 10 inches deep. A larger proportion of this soil is used for cultivated crops than of any other soil in the county. Both manure and commercial fertilizer are used, the market-garden farmers using as much as 1,500 pounds of high-grade fertilizer to the acre.

Most of this land is in small holdings. Much of it is desirable for building sites and is held at a price higher than its agricultural value would warrant. The current selling price ranges from \$50 to \$300 an acre and is higher for the best-located land. The price of good farm land is from \$65 to \$150 an acre, depending on improvements.

This soil is highly adapted to market gardening and is especially suited to the growing of potatoes. It is used in the Connecticut Valley for the production of tobacco.

MERRIMAC LOAM

The topsoil of Merrimac loam, to a depth of 8 or 10 inches, is dark-brown mellow loam. It is underlain by a subsoil of yellowish-brown, firm loam or sandy loam which continues to a depth of about 20 inches, where it grades into pale yellowish-brown, yellow, or grayish-yellow gravelly sand, fairly loose and open in structure. The gravel consists of quartz, granite, and slate, and some pieces are several inches in diameter. The substratum is gray gravelly sand.

This soil occurs on low, level terraces along present stream courses and filled-in lakes. Drainage is well established. The position of the soil and the character of the surface material aid it to retain moisture better than the other Merrimac soils. For this reason the surface soil is darker than is common with the Merrimac soils.

Merrimac loam occurs in widely scattered areas. Areas of fair size are in the towns of Dracut, Framingham, and Natick, and along the line between Waltham, Watertown, and Newton Towns. A small area is in Groton Town.

This soil, though not extensive, is nearly all cleared and farmed, with the exception of the area covered by town developments. A number of lots and fields that are soon to be used for building lie fallow. Where farmed, this soil is used for mowing, pasture, corn (silage and sweet), oats, clover, and nearly all the vegetables grown in the Boston market-garden district. A few dairies are in operation, and a large area is in market-garden crops. Crop yields are usually good. Hay cuts from 1 to 2 tons to the acre and corn (silage) from 10 to 12 tons. Vegetables give good yields, as they are highly fertilized.

Manure and fertilizer are used on this soil, and liming is practiced by some farmers. This land is easy to till but can not be plowed so soon after rains as the lighter-textured Merrimac soils. In the fall it is plowed from 8 to 10 inches deep, and in the spring it is harrowed to bring it into good tilth.

The current selling price of Merrimac loam is from \$100 to \$250 an acre or more, depending on the location and improvements.

Merrimac loam is usually not so deficient in organic matter as are the other Merrimac soils, and, in general, it is better farmed. It is fairly well suited to market-garden crops, such as cabbage, kale, lettuce, celery, beets, carrots, and tomatoes.

MERRIMAC LOAMY SAND

Where forested the topsoil of Merrimac loamy sand consists of a surface layer, 1 or 1½ inches thick, of dark-brown or almost black loamy sand or coarse sand mixed with organic matter, underlain by a layer, several inches thick, of brown or coffee-brown loamy sand or coarse sand. In cleared areas the topsoil is brown loamy sand or coarse sand to a depth of 6 or 8 inches. The subsoil is yellowish-brown loamy sand containing some gravel to a depth of 12 or 15 inches. Below a depth of 24 inches the subsoil becomes gray and is composed of loose, medium-textured sand containing some gravel. The substratum is composed of beds of loose, incoherent gray sand and gravel composed mostly of granitic material of medium texture.

Areas of Merrimac loamy sand are fairly level. Drainage is internal and inclined to be excessive, as the porosity of the topsoil, subsoil, and substratum permits free movement of water.

Merrimac loamy sand is one of the most extensive soils in the county. It is found in the towns of Groton, Tewksbury, Townsend, Shirley, Ayer, Concord, Sudbury, and Framingham, and scattered areas are in Sherborn Town. About 60 or 70 per cent of the soil is covered by second-growth oak, scrub oak, gray birch, chestnut, and white pine, and a number of fallow fields contain broom sedge and cinquefoil. This land, where farmed, is used for mowing, pasture, field crops, and market gardening. Corn (silage), oats, rye, and millet are the principal crops. Sweet corn, asparagus, squash, and potatoes are the chief vegetables grown for market, although other vegetables common to this county are grown in home gardens and to a small extent for market. Most farmers keep chickens, and there are a number of poultry ranches. Dairying is carried on to a small extent.

Crop yields are low, except on highly fertilized soil or in wet seasons. Crops suffer in extremely dry seasons and, to some extent, in moderately dry spells. Hay yields from one-half to 1 ton to the acre on the average farm, but higher yields are obtained where the soil has been built up by turning under crops or manure. Asparagus makes fairly good yields, but it is always highly fertilized. The other crop yields are fair or poor.

Redtop, timothy, and clover are used for hay, and when the hay crop is cut short by dry weather millet is sown as a supplementary hay crop. Grass does not thrive, so little of the land is in permanent pasture, but when the mowings fail they are pastured. Asparagus, the chief specialty crop on this land, is grown mainly in the vicinity of Concord. It is grown in comparatively small patches and is intensively worked and highly fertilized. It is sold on the Boston market.

The selling price of Merrimac loamy sand ranges from \$20 to \$200 an acre, depending on the location, improvements, and forest condition. Cut-over areas grown up mainly in scrub oak sell for a comparatively low price.

As the organic-matter content in this soil is usually low, it should be increased to improve the moisture-holding capacity of the soil. Merrimac loamy sand has a low natural productiveness, and fertilizers to suit the crop grown should be used. Light market-garden crops, brier berries, and small fruits are the most profitable crops.

MERRIMAC GRAVELLY LOAM

The topsoil of Merrimac gravelly loam is dark-brown, mellow gravelly loam 6 or 8 inches thick. It is underlain by a subsoil of yellowish-brown light gravelly loam or gravelly sandy loam. Below a depth of 15 or 20 inches the subsoil is light-yellow gravelly sandy loam, loose and open in structure, which passes, below a depth ranging from 24 to 30 inches, into grayish-yellow or gray gravelly sandy loam or gravelly loamy sand, more open in structure than the subsoil above. The substratum is composed of unconsolidated beds of assorted gravel and sand. The gravel is mainly rounded quartz and granite, with some schist and slate, and is rarely larger than a few inches in diameter.

Areas of Merrimac gravelly loam are fairly level, but there are some low swells. Drainage is well established, the gravelly substratum giving perfect underdrainage.

Merrimac gravelly loam occurs in fairly large areas in the southeastern part of the county and in smaller areas scattered over other parts. The largest areas are in Cambridge, Somerville, Arlington, Belmont, Medford, and Malden Towns. The other areas are small and irregular and usually occur on narrow terraces between the streams and the uplands.

Although practically all cleared, only a small proportion of this land is used for farming. Much of it is included in cities and towns. The small area farmed is in market-garden crops. These farms lie in what is termed the Boston market-garden district and are exceptionally well farmed. The two-crop system is in operation and many greenhouses and coldframes are in use. Cucumbers, lettuce, beets, tomatoes, celery, carrots, and squash are the leading crops. The yields are usually heavy, as large applications of manure and commercial fertilizer are used.

This land, where located near larger towns, is held at a price that is usually higher than the agricultural value. In the most favored localities it sells for \$1,000 an acre, but some of the outlying farms sell for prices ranging from \$30 to \$150 an acre, depending on improvements.

MERRIMAC GRAVELLY SANDY LOAM

The topsoil of Merrimac gravelly sandy loam is dark-brown or brown mellow gravelly sandy loam from 6 to 8 inches thick. The subsoil is yellowish-brown friable gravelly sandy loam which grades, at a depth of 15 or 20 inches, into pale-yellow or pale yellowish-brown light material of gravelly sandy loam or gravelly loamy sand texture, fairly loose and open in structure. Below a depth ranging from 24 to 30 inches the subsoil becomes gray or yellowish-gray gravelly loamy sand or gravelly coarse sand. The substratum is composed of beds of assorted sand and gravel, with few stones larger than 6 inches in diameter.

The deposits that gave rise to this soil consist of outwash material from glaciers formed as terraces along the streams which emerged from the edge of the glacier. The deposits occur in the old stream valleys, range from 20 to 100 feet in thickness, and are derived largely from granitic material with a slight admixture of schist. The gravel associated with this soil is mostly of granitic material. Areas are fairly level or slightly undulating and contain a few well-defined

swells. Drainage is internal and is well established, to the extent that the soil is inclined to be droughty in dry seasons. The surface gravel seems to act as a mulch, helping to conserve the moisture.

Merrimac gravelly sandy loam occurs in nearly all parts of the county, the largest areas being in the north-central part, in Littleton, Westford, Woburn, Winchester, Stoneham, and Melrose Towns.

This soil is not very extensive, and much of it is covered by towns. Probably less than 25 per cent is forested by second-growth white pine, oak, birch, and chestnut. About 50 per cent is devoted to general farming, orcharding, dairying, and market gardening. The crops grown are hay (timothy, redtop, and clover), corn (silage, grain, and sweet), oats, millet, rye, and buckwheat. There is a fair acreage in mowing and a small acreage in pasture, but the pastures contain a considerable growth of birch sprouts, sweet fern, briars, and blueberries. A number of fallow fields support a growth of broom sedge and cinquefoil. A number of small home orchards and a few commercial orchards, in which apples predominate but in which nearly every fruit common to this region is grown, are found. Market gardening is carried on to some extent. Nearly all the vegetables grown for market in this county are found on this soil, but asparagus is the only one grown on a large acreage. A few farmers make a specialty of chickens.

Hay yields range from 1 to $1\frac{1}{2}$ tons to the acre on the best-farmed land and from one-half to 1 ton on the remainder; corn yields from 35 to 50 bushels, oats from 30 to 50 bushels, and potatoes from 100 to 150 bushels. Good yields of vegetables are obtained, especially where the land is highly fertilized. Apples do fairly well but are not of such good quality as those produced on the hill land.

This soil is easy to cultivate. It is plowed 8 or 9 inches deep and can be brought into good tilth without difficulty. As a rule it is not allowed to stand in mowing so long as the upland soils before being put into cultivated crops. Commercial fertilizer is used to a small extent, except on market-garden crops which receive from 1,000 to 1,500 pounds to the acre.

The current selling price of Merrimac gravelly sandy loam ranges from \$30 to \$250 an acre, depending on the location and improvements. Brush-covered areas sell for \$30 or \$40 an acre, good farm land for \$75 or \$100 an acre, and land near cities or land held for building development for higher prices.

Most of this soil, like the other Merrimac soils, is deficient in organic matter. Much of it is sour, and from 1,000 to 1,500 pounds of lime to the acre should be applied to improve this condition.

ORONO LOAM

The topsoil of Orono loam is dark-brown or dark yellowish-brown mellow loam, from 8 to 15 inches thick. The subsoil is greenish-yellow firm loam, faintly mottled with spots of brown. Below a depth of 24 or 26 inches the subsoil grades into heavy clay mottled with yellow, brown, greenish gray, and gray. This layer continues to the depth of the formation. The deep substratum is calcareous.

This soil occurs on low, flat, imperfectly drained areas that were evidently laid down under marine conditions. The largest areas are in Belmont, Arlington, Cambridge, Somerville, Medford, and Malden Towns.

This soil is not extensive in area. Parts of it are used for city, town, and industrial development, and much of it is included in reservations and parkways. The small area cultivated is used almost entirely for the production of market-garden crops. Celery, lettuce, cabbage, beets, and carrots are the leading crops, but nearly all the varieties of vegetables grown in the Boston trucking district are produced in small quantities.

Farming on this land is very intensive, and the yields are exceptionally good. Large quantities of lime, manure, and commercial fertilizer are used.

The price of this land, owing to its location, is exceptionally high. Within a very short time all of it will be covered with buildings.

SUDBURY LOAM

In forested areas the topsoil of Sudbury loam consists of a surface covering, about 1 inch thick, of dark-brown or almost black loam, containing a high proportion of forest mold, underlain by dark-brown or brown loam 4 or 5 inches thick. Where cleared, the topsoil is dark-brown loam 8 or 10 inches thick. The subsoil, to a depth of 12 or 15 inches, is yellowish-brown firm loam which grades into greenish-yellow or pale-yellow firm loam. Below a depth of 30 inches, the subsoil is brown sandy loam mottled yellow and brown, greenish yellow, or gray. The material is less compact and more open in structure than the upper part of the subsoil.

This soil occurs on low terraces along Sudbury River, and areas are level or slope gently toward the stream. Drainage is good, except in the lower part of the subsoil and substratum where it is retarded to some extent.

This soil is not extensive but is fairly important. Probably more than half of it is cleared and farmed. The remainder is forested, mainly with oak, birch, maple, and white pine. The cleared areas are in mowing, pasture, field crops, and vegetables. Corn (silage, grain, and sweet) and oats are the principal crops. Cabbage, chard, lettuce, celery, and squash are the main vegetables grown for market, although others are grown to some extent.

Crop yields are usually good. Hay cuts from 1 to 2½ tons to the acre and corn for silage from 10 to 15 tons. Field corn and oats give good yields, and vegetables do exceptionally well. Manure is used for field crops, and both manure and fertilizer are used for market-garden crops. Small quantities of lime are applied.

Sudbury loam is desirable land for general farming and market gardening. The current selling price of farm land ranges from \$100 to \$250 an acre, depending on improvements. The location of most of this land is good. Some of the uncleared cut-over areas sell for less than the cleared land.

This soil is adapted to growing vegetables, and this form of farming could be easily extended. It is a valuable soil for growing hay and forage crops in conjunction with dairying. Most of it is sour and must be limed before clover can be successfully grown. In its present state, alsike clover will do better than red clover.

ONDAWA FINE SANDY LOAM

In forested areas Ondawa fine sandy loam, to a depth of a few inches, is very dark grayish brown or almost black. Where cleared, it is dark-brown or brown mellow fine sandy loam from 6 to 10 inches thick. The subsoil is yellowish-brown mealy fine sandy loam which, at a depth of 18 or 20 inches, grades into pale-yellow mealy fine sandy loam or fine sand, faintly mottled in places or showing rust-brown streaks. Below a depth ranging from 30 to 36 inches, the substratum is gray somewhat compact fine sand or sand.

This soil occurs as bottom or overflow land along the larger streams of the county. The most extensive areas are along Merrimack, Nashua, and Squannacook Rivers, and smaller areas are along Charles, Assabet, and Sudbury Rivers. Areas are near the stream and lie slightly higher than the remainder of the bottom land, the elevation above stream level ranging from 5 to 25 feet. The soil is not inundated with every overflow but is covered by the spring freshets. Areas are level and drainage is well established. These deposits are close enough to water level to be affected by underground water and are thus supplied with moisture even during dry seasons.

This soil, though not extensive in area, is fairly important. Nearly all of it is cleared, and the part not occupied by towns or city development is farmed. A considerable acreage is in mowing and pasture. Corn (silage, grain, and sweet), oats, rye, potatoes, and market-garden crops are grown. Of the vegetables grown for market, cabbage, onions, lettuce, celery, carrots, squash, tomatoes, rhubarb, and cucumbers are the most important.

Crop yields are usually good. Hay (timothy) yields from 1 to 2½ tons; corn (grain) from 40 to 60 bushels; corn (silage) from 12 to 15 tons; oats from 30 to 60 bushels; and potatoes from 100 to 150 bushels to the acre. Vegetables give exceptionally good yields.

This land is easily plowed and cultivated, coming readily into good tilth. It is usually plowed to a depth of 8 or 10 inches. Little manure or fertilizer is used, except with market-garden crops. The overflow in spring is depended on in a measure to keep up fertility. Comparatively small deposits are made by the streams of this region at flood time. Crops are rarely damaged by floods, which occur at times when little or nothing is growing on the land. Timothy and redbud are used for mowings.

The current selling price of Ondawa fine sandy loam ranges from \$50 to \$150 an acre, depending on improvements and location.

This land is well suited to grass, corn, and vegetables, and these crops should constitute the bulk of the crops grown. Where vegetables are grown, complete fertilizers should be used, but in slightly smaller quantities than on the Merrimac soils. Manure should be used with corn and vegetables.

MEADOW

Meadow, as mapped in Middlesex County, includes all the bottom land or overflow land, other than muck and peat, that occurs along streams and could not be classed with a definite soil series or type.

The topsoil, generally dark brown or black, ranges in texture from fine sandy loam to sandy loam and loam or muck and in thickness from 5 to 15 inches. The subsoil, to a depth of 20 or 24 inches, is fine sandy loam, sandy loam, or loam, dark gray or dark yellowish gray mottled with brown and drab, and is fairly firm. It grades downward into gray or drab-gray compact sand, fine, medium, or coarse in texture.

In places on Squannacook River above Harbor Pond in the town of Townsend, the soil is dark-brown or almost black fine sandy loam 6 or 8 inches thick, grading into dark-brown or brown fine sandy loam, which continues to a depth of 18 or 20 inches where it grades into gray or gray mottled with yellow and brown fine sand.

Small scattered areas along the edge of the flats that border Sudbury River and contiguous territory have a dark-brown or black heavy fine sandy loam, loam, or muck surface soil, 10 or 15 inches thick, underlain by fairly firm dark-yellow, yellowish-gray, or gray loam which grades, at a depth of 20 or 24 inches, into gray or drab clay.

Meadow is rather extensive, occurring on the flood plains of most of the streams in strips ranging from one-fourth to one-half mile in width. It lies near water level, in few places being more than a few feet above water along the smaller streams or more than 5 feet along the larger ones. Areas are level, and the drainage is poor.

This land is fairly important. From 40 to 50 per cent of it is cleared and used for farming. The remainder is forested with white, gray, and brown birch, soft maple, elm, and willow, and alder and high-bush blueberries abound in the underbrush. The cleared areas are used extensively for mowing and pasture, and a smaller area is in oats and corn (silage, field, and sweet). In the vicinity of Concord, meadow is used for the production of market-garden crops. Here it has a heavy subsoil, has been drained, and yields good crops of sweet corn, squash, rhubarb, cabbage, chard, Brussels sprouts, cauliflower, lettuce, and celery.

Crop yields are usually good even in dry seasons. Hay cuts from 1 to 2½ tons to the acre, and pastures furnish good grazing. Timothy and redtop are used for mowing. In places the native grass gives fairly heavy yields of low-quality hay. Permanent pastures are maintained and, after the timothy fails, mowings are used for pasture longer than on most soils. In many pastures bulrush and other coarse swamp grasses abound. Open ditches are depended on to remove most of the drainage water, although on a few farms tile drains have been installed.

Meadow land has a wide range in value, as some of it is well located and highly improved and some of it is more remote and in its native condition, except that the timber has been removed. The current selling price ranges from \$10 to \$250 an acre, the average being between \$25 and \$50 an acre.

Adequate drainage is the greatest need of most of this land. Where properly drained it produces, without the use of fertilizer, fair or good crops of hay, corn, oats, and vegetables. It is well suited to market-garden crops which thrive on a fairly moist soil. It is valuable land to use in connection with dairying for pasture, mowing, or for the production of silage.

MUCK AND PEAT

Muck and peat are not separated on the soil map of Middlesex County, but muck is probably the more extensive. To a depth of 12 or 15 inches, it consists of black, finely divided organic matter containing some mineral soil material. This layer is underlain by dark-brown or almost black, less-decomposed organic matter which continues to a depth of 18 or more inches, depending on the thickness of the deposit. These deposits vary in thickness, in most places being between 2 and 3 feet but in many places continuing to a depth of 5 or 6 feet. Muck nearly everywhere is underlain by a compact bed of gray or white sand, but in some places the beds are of heavier material. Muck is found in the stream bottoms and around the edges of the larger swamps that have peat deposits in the center.

Peat deposits consist of a brown fibrous mass of organic matter, the deeper part containing much woody fiber of trees and plants. Peat is less compact, shows a much less advanced stage of decomposition, and contains much less mineral material than muck. The peat deposits are deep, ranging from 3 feet to 30 feet and even deeper, depending on the depth of the depressions in which they are found. Most of the peat occurs in filled-in lake beds.

Areas of both muck and peat are level, and water stands on the surface during most of the year. Deposits are more or less spongy and unfirm at all times.

This soil, although one of the most extensive in the county, is for the most part of no present agricultural value. Many large areas are affected by backwater from dams of industrial plants and are not likely to be released at any time in the future. Many areas lie near the water level of some of the larger streams, and it would require a great outlay to drain them properly. About half of this soil is covered with a growth of birch, soft maple, willow, alder, and, in places, tamarack. Large areas are covered, at the present time, with wild grasses, and there is no indication that they ever supported tree growth. The area of this land cleared is small compared with its total area. Some of the cleared areas are used for mowing and pasture. Some of the open areas are used for mowing in their natural condition, and from these places a coarse grass, which is of low value, is cut for hay. In Carlisle Town several bogs have been drained, covered with a layer of sand several inches thick, and used for cranberries. In the vicinity of Lexington and Concord, this land has been drained and is used for market gardening. Celery, lettuce, onions, and sweet corn are the main crops, but most of the varieties of vegetables common to this region are grown. Some corn (silage) and oats are grown.

The yields of hay range from 1 to $1\frac{1}{2}$ tons to the acre, the coarse grasses yielding a little more. Corn and oats give fairly good yields, considering that little attention is given to these crops. Cranberries yield from 10 to 18 barrels to the acre. Vegetables give good yields.

Where this land has been under cultivation for some time, it has a tendency to compact, and the surface sinks several feet below its former level, leaving less depth of the muck material over the substratum. This has happened to a marked degree in some of the market-garden

areas. Where used for vegetables this land has been well drained, and in some places tile drains have been installed. Where continuously cropped to vegetables the productive power has decreased to the point where large applications of manure and commercial fertilizer are necessary.

Muck and peat have a wide range in market value, depending on improvements and location. The value of unimproved areas is low. Most of this land is assessed at \$10 an acre. The price of improved areas ranges from \$50 to \$250 an acre and is even higher in the best locations.

TIDAL MARSH

Tidal marsh consists of marshy areas covered, to a depth of a few inches, by water at each high tide and exposed at low tide. The soil ranges from black, fibrous, mucky material and sandy muck to firm silt loam or silty clay loam of dark-gray or drab color, mottled with specks of brown. The soil grades, at a depth of 10 or 12 inches, into the subsoil which may have the same coloring but which is in many places blue or bluish gray. Normally it has the consistence of soft mud. The vegetation consists of coarse salt grasses and eel-grass, and both topsoil and subsoil are filled with the roots of these grasses, both live and partly or wholly decomposed. Most of the tidal marsh is highly impregnated with salt, and the subsoil gives off a strong odor of hydrogen sulphide.

Tidal marsh in this county is not extensive. It occurs exclusively on the tidal flats that border Mystic River. At one time these flats were much more extensive than they now are.

MADE LAND

In the vicinity of Boston, its suburbs, and surrounding cities several areas along the streams and tidal flats have been filled in with refuse and dirt from excavations. These areas have been indicated on the soil map as made land. They are used largely for building and industrial developments and have no agricultural value.

ROUGH STONY LAND

Rough stony land includes all land too rough and stony or too stony to be used advantageously for farming. The soil material varies according to the soil with which it is associated, but most of it is Gloucester material.

The most extensive areas are in Middlesex Fells, in the region northeast from Ayer, and in the northwestern part of the county in Ashby Town. Smaller areas are in the northern part of Townsend and in Hopkinton Towns and elsewhere, on high knobs like Gibbs Mountain and Prospect Hill.

Areas of rough stony land range from steep and broken to smoothly sloping. In the northwestern part of the county this land is found mainly on the steep valley walls of the preglacial streams, where in many places it forms cliffs. In other places it occurs on the mountains and caps the highest hills where glacial drift is thin. In other places, as in the eastern part of the county, it occurs as comparatively level areas where the surface material was removed by the glacier and little or no material was redeposited. In other places it occurs as drift that contains a large quantity of stone.

The drainage of most of the rough stony land is well established. Most of the drainage water passes off through surface channels, which in the steeper areas are dry runways, except during rainy weather. Some of the drainage is internal. In places seepage water from higher ground comes out on the hillsides. In a few more level or stony places between hills drainage is poor. Most of these areas are small.

Rough stony land, although extensive, is of little agricultural importance. Only a comparatively small total area is cleared. The cleared land is used for pasture. The forest consists of oak, chestnut, poplar, maple, birch, white pine, in places pitch pine, and in others spruce and mountain laurel. The pastures furnish only fair grazing, as most of them have grown up in brush. This land supports little valuable timber at the present time. Most of the timber has long since been removed and is either cut out as fast as it becomes of merchantable size or is cut into cordwood before it reaches that stage.

Rough stony land sells for prices ranging from \$5 to \$25 an acre, unless it supports merchantable timber. The price of wooded tracts varies with the value of the timber. Considerable areas of this land are held for building purposes, and here the value is very high. Where it contains workable stone, the value is higher than the average.

This land should be left in forest. Much of it already is in State, town, and private reservations and supports some good timber.

SUMMARY

Middlesex County is in the eastern part of Massachusetts. It contains 832 square miles, or 532,480 acres.

Physiographically it consists of a high, dissected plateau in the western part and a subdued plateau, interspersed with lower basins of smooth land, in the eastern part. The county is well drained, with the exception of the lower overflow land and marsh along the streams and coast, and of the filled-in lakes. The average elevation of the hilltops and ridges is 500 feet above sea level.

The population in 1920 was 778,352. The towns and cities of the Boston metropolitan district are the most thickly settled parts of the county. Cambridge, Somerville, and Lowell are the largest cities, all having more than 100,000 inhabitants. Boston and its suburban towns are the principal markets.

The climate is humid, and the rainfall is well distributed through the year. The snowfall is heavy.

The agriculture of the county consists of dairying, orcharding, market gardening, poultry raising, and general farming in connection with these industries. Hay (timothy and clover), corn, oats, potatoes, and vegetables are the main crops, and rye, buckwheat, millet, and wheat are the minor crops. A considerable acreage is in pasture.

Approximately half the county is in farms, and half of this area is improved. The farming methods in general are those followed on most New England farms. The buildings and equipment are adequate for the type of farming followed.

Feed is bought mostly by the dairymen and poultry raisers. Most of the fertilizer is used on market-garden farms and on the orchards.

Labor is hired on more than half the farms. Most of the permanent labor is employed by the dairymen and transient labor by the market gardeners and fruit growers.

The average value of farm land in 1920 was \$76.75 an acre. The average size of farms, as reported by the same census, was 57.8 acres.

The soils of Middlesex County have developed under the influence of a humid climate with moderately high rainfall and snowfall, low average temperature, and a forest vegetation. These soils, in the virgin state, have an accumulation of forest litter and leaf mold on the surface, underlain by dark-brown or dark grayish-brown mineral soil which extends to a depth varying from 4 to 8 inches. The subsoils are yellowish brown, becoming paler and less influenced by weathering with depth. They grade into the raw parent material at an average depth of 2 feet. There is no accumulation of clay and colloids within the weathered horizons.

This county is in the glaciated region. There is a thin deposit of glacial drift over the bedrock of most of the upland, and in isolated areas are thicker deposits or drumlins and outwash material deposited in the preglacial valleys in hummocky forms, kames and eskers, and level terraces. The bedrock which has contributed to the parent-soil materials consists of granite, gneiss, and associated igneous rocks, which crop out over large areas. Schist and phyllite crop out in narrow strips, and sandstone, slate, and conglomerates occur in small basins. In the larger areas the parent material is little influenced by foreign material.

The soils developed on the upland drift are mapped in the Gloucester, Coloma, Charlton, Brookfield, Paxton, Dutchess, Hollis, Bernardston, Whitman, and Hinckley series. Terrace soils underlain by water-laid drift are grouped in the Merrimac, Orono, and Sudbury series. Organic soils are grouped together as muck and peat. First-bottom overflow lands are Ondawa fine sandy loam and the miscellaneous classes of land, meadow and tidal marsh. Rough stony land includes stony, nonagricultural land, and made land consists of the areas of tidal marsh and meadow which have been filled in by débris from the cities and towns.

The soils of the county are classified in 14 soil series, including 41 soil types and 10 phases, and in 5 miscellaneous classifications, including muck and peat. The sandy loam, fine sandy loam, and loam soils are used most extensively for agriculture. Some of the areas of stony soils are in pasture, but most of them are covered with second-growth timber and sprouts.



[PUBLIC RESOLUTION—No. 9]

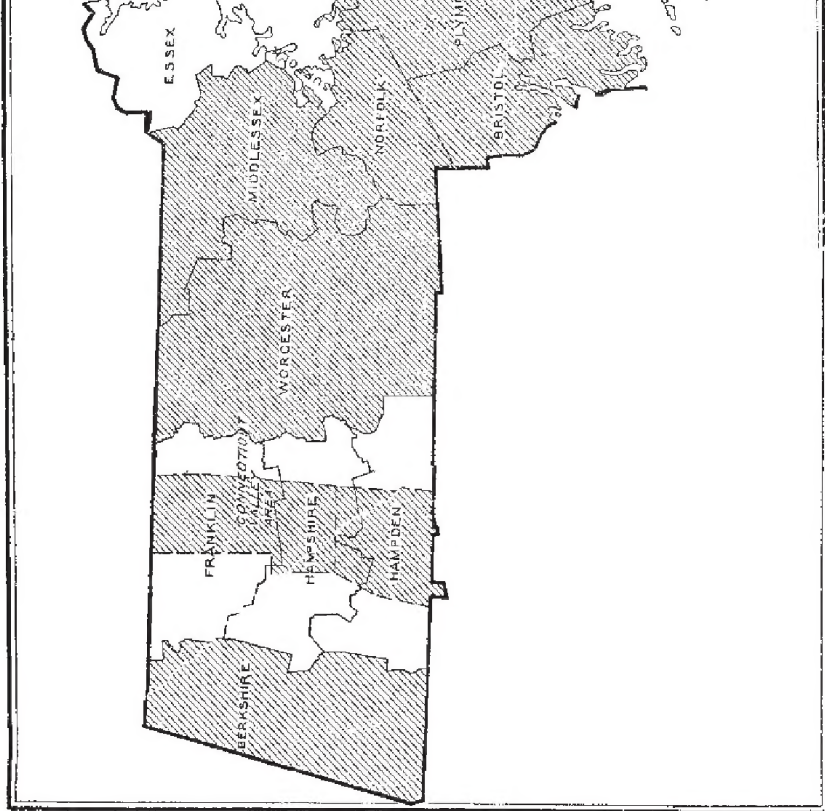
JOINT RESOLUTION Amending public resolution numbered eight, Fifty-sixth Congress second session, approved February twenty-third, nineteen hundred and one, "providing for the printing annually of the report on field operations of the Division of Soils, Department of Agriculture."

Resolved by the Senate and House of Representatives of the United States of America in Congress assembled, That public resolution numbered eight, Fifty-sixth Congress, second session, approved February twenty-third, nineteen hundred and one, be amended by striking out all after the resolving clause and inserting in lieu thereof the following:

That there shall be printed ten thousand five hundred copies of the report on field operations of the Division of Soils, Department of Agriculture, of which one thousand five hundred copies shall be for the use of the Senate, three thousand copies for the use of the House of Representatives, and six thousand copies for the use of the Department of Agriculture: *Provided*, That in addition to the number of copies above provided for there shall be printed, as soon as the manuscript can be prepared, with the necessary maps and illustrations to accompany it, a report on each area surveyed, in the form of advance sheets, bound in paper covers, of which five hundred copies shall be for the use of each Senator from the State, two thousand copies for the use of each Representative for the congressional district or districts in which the survey is made, and one thousand copies for the use of the Department of Agriculture.

Approved, March 14, 1904.

[On July 1, 1901, the Division of Soils was reorganized as the Bureau of Soils, and on July 1, 1927, the Bureau of Soils became a unit of the Bureau of Chemistry and Soils.]



Areas surveyed in Massachusetts, shown by shading

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Washington, D.C. 20250-9410;
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